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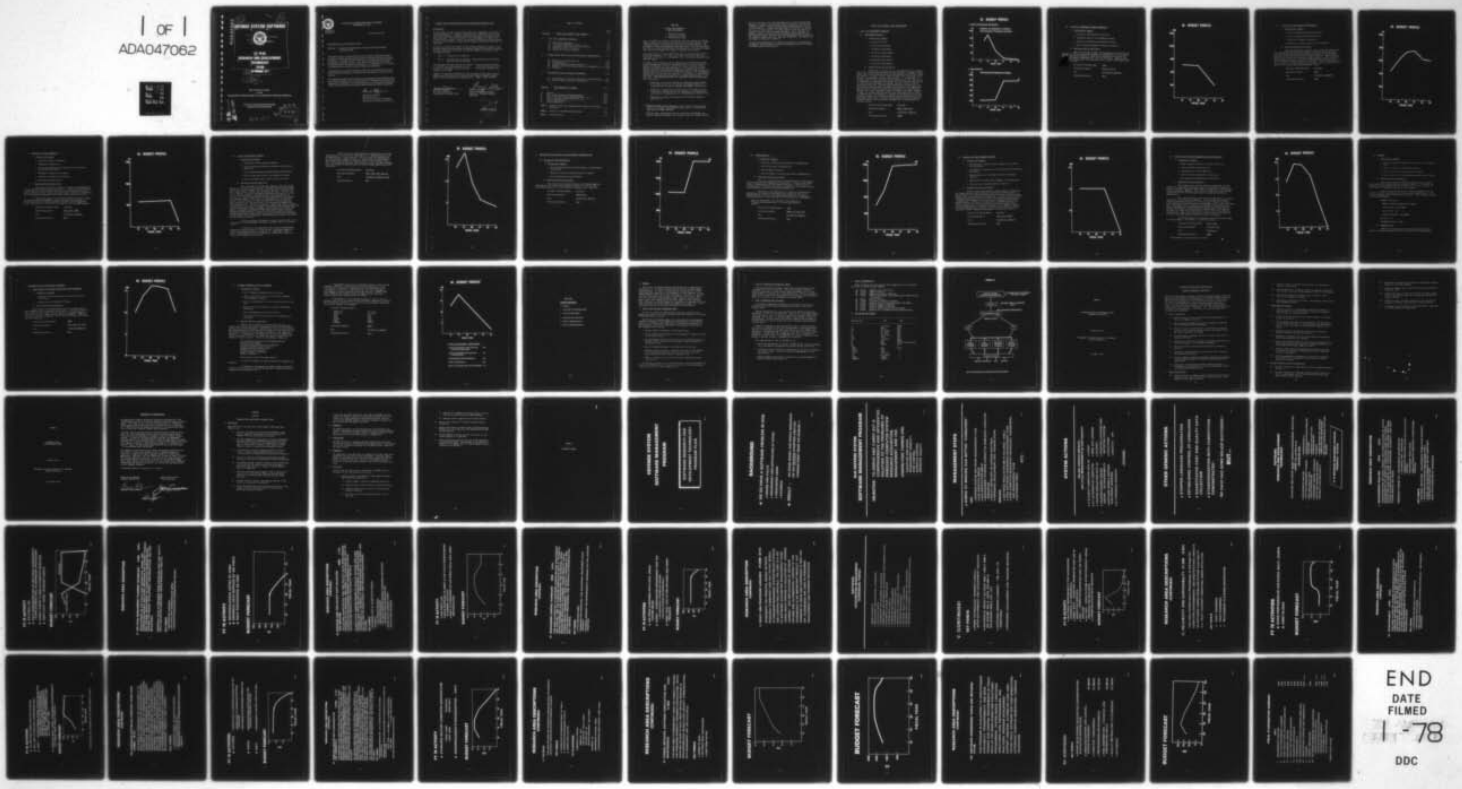

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DEFENSE SYSTEM SOFTWARE

FY 79-83 RESEARCH AND DEVELOPMENT TECHNOLOGY PLAN

SEPTEMBER 1977

86p.

R&D TECHNOLOGY PANEL

TO THE

MANAGEMENT STEERING COMMITTEE FOR EMBEDDED COMPUTER RESOURCES

OFFICE OF THE DIRECTOR OF DEFENSE
RESEARCH AND ENGINEERING

OFFICE OF THE UNDER SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

RESEARCH AND
ENGINEERING

18 November 1977

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Defense System Software Research and Development Technology Plan

The attached plan is distributed for use by Military Department R&D managers in planning and evaluating their technology initiatives relating to software. The plan has been informally coordinated within Military Department technology centers, and carries the approval of the R&D Technology Panel on Software Technology. It is intended to be a "living" document and as such will undergo continuing refinement.

The Software Science and Technology Base is a major DoD thrust area, and the program expansion outlined by the attached plan carries my full support.

The Management Steering Committee for Embedded Computer Resources will assist the Office of the Under Secretary of Defense for Research and Engineering (OUSDRE) in its responsibility for overseeing the implementation of the plan within the Military Departments and defense agencies.

Thomas H. Nyman

Thomas H. Nyman
Staff Specialist for
Electronic Systems Technology
Electronics and Physical Sciences

DEFENSE SYSTEM SOFTWARE RESEARCH AND DEVELOPMENT TECHNOLOGY PLAN

Introduction

In the Spring of 1975, a major new initiative was undertaken in the area of software management for weapons, communications, command and control, and intelligence systems. Organizational steps which give the proper leverage have been taken; OSD policy direction on the management of computer resources has been issued; impacts are gradually being made on major systems; visibility of software as a major system component and decision parameter is being felt.

In order to complete the Defense System Software Management Program, a supporting research and development technology program plan has been formulated. The plan, described in detail in the attached paper, is divided into the following Sections:

Part I Technology Area Summaries

Part II DoD Management of Program - Organizational Roles, Responsibilities, and Interactions

The Management Steering Committee for Embedded Computer Resources intends to carry out the steps described in this plan and to seek the support of the Service Components, Federal Contract Research Centers, Industry, and Congress in so doing.

Comments or questions regarding material contained in this paper should be addressed to Mr. William E. Carlson, Defense Advanced Research Projects Agency, 1400 Wilson Boulevard, Arlington, VA. 22209, (202) 694-5051.

William E Carlson
WILLIAM E. CARLSON
For the Research and
Development Technology Panel

Barry C. De Roze
BARRY C. DE ROZE
For the Management Steering
Committee - Embedded Computer
Resources

TABLE OF CONTENTS

PART ONE

SCIENCE AND TECHNOLOGY AREA DESCRIPTIONS

- Problems Addressed
- Actions to be Taken
- Funding Requirements

There is probably no technical development that has produced as profound change in military systems in the past ten years as the computer. Revolutionary advances in integrated circuits have fostered multiplied improvements in both processing power and small size. Over the last decade, the cost for a given processing task has plunged over two orders of magnitude, and trends suggest this dramatic reduction will continue.

The overall effect of these advances has been to provide highly capable processing equipment at low cost, while elevating both the cost and complexity of software to a predominant factor in defense systems development and support.

To address this increasing cost and complexity, the DoD Defense System Software Management Program has implemented specific policy thrusts to improve the management of the software life cycle in defense systems. The plan outlined in the following pages is an essential part of the Defense System Software Management Program and provides the technological know-how and tools critical to achieving full success of the comprehensive software policy initiatives now underway.[1] It provides for considerable expansion in improved software quality and reduced software costs in the near term. The technology thrusts are organized in the following pages into three areas:

- Technology to help both the DoD and industrial program manager better plan and control the software development process (as an integral part of overall systems development) (Section I-A).
- Technology to advance the state-of-the-art in software quality, reliability, transportability and adaptability, including the investigation of opportunities for standardization (Section I-B).
- Technology to improve the productivity of software engineers (Section I-C).

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[1] "Defense System Software Management Plan," Office of the Assistant Secretary of Defense (Installations and Logistics), 19 March 1976 (DDC Accession Number A022558).

[2] Includes basic and applied research, exploratory development and generic advanced development not related to specific defense systems.

The plan outlined in the following pages will be used by defense R&D managers to formulate, monitor and evaluate progress of the software technology program. Broad goals have been established which are presented in Annex A. Program tasks undertaken in Part One will address one or more of these goals. To assist with the technical aspects of program formulation and technology assessment, and to integrate the embedded computer systems area and the general purpose ADP area, an R&D Technology Panel, chartered under the Management Steering Committee for Embedded Computer Resources, has been established. The Charter for this Panel is contained in Annex B.

The R&D Technology Plan will be modified periodically as required to accommodate the advancement of software technology and the fulfillment of defense software deficiencies.

SCIENCE AND TECHNOLOGY AREA DESCRIPTIONS

A. LIFE CYCLE MANAGEMENT TECHNOLOGY

A1. REQUIREMENTS ANALYSIS

I. Problem/Issue Summary

- o Dissatisfied Users
- o Excessive Requirements
- o Incomplete Requirements
- o Inconsistent Requirements
- o Untestable Requirements
- o Untraceable Requirements
- o Infeasible Requirements

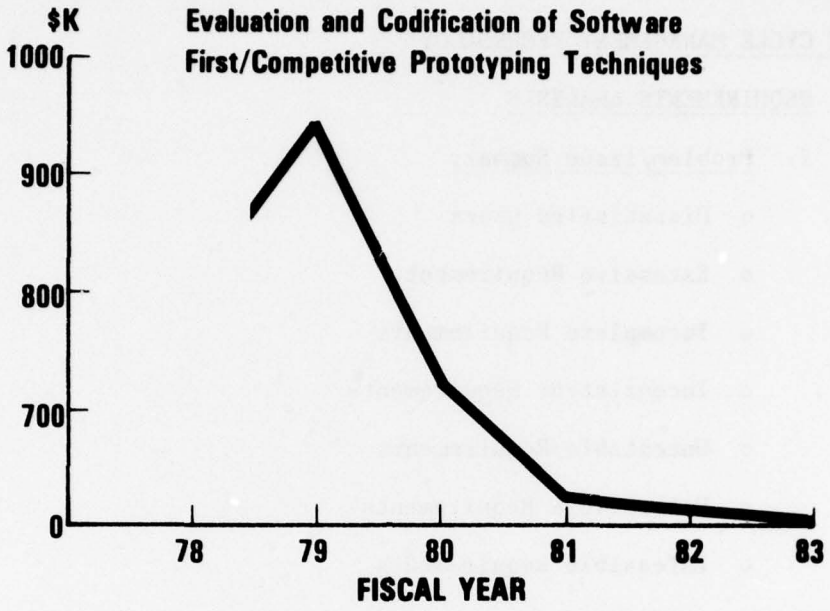
II. Research Direction and Action

Requirements specification is, and always will be a problem. The process involves the transformation and synthesis of thoughts, desires, needs, fears, and perceptions into a precise specification of the problem the system is to solve. We will always be faced with conflicting, inconsistent, and changeable missions, and responses. It is important to recognize that we cannot technologically eliminate this fact, and instead to concentrate on providing rapid insight into the technical implications of stated system requirements on computer resources (and vice versa), identifying risk areas, and exploring implementation alternatives iteratively before making hardware, schedule, and projected cost commitments. The user needs to have the closed-loop opportunity to see and feel the implications of his requirements before he becomes irrevocably committed to them. Our primary research thrust in the near-term, then, is aimed at "Software First" Technology (in conjunction with emulation facilities testbeds); Competitive Prototype Guidelines and Evaluation Criteria; and Requirement Trace Tools. Tools for Semi-Automated Consistency and Completeness Analysis and Requirements Decomposition are promising basic research thrusts.

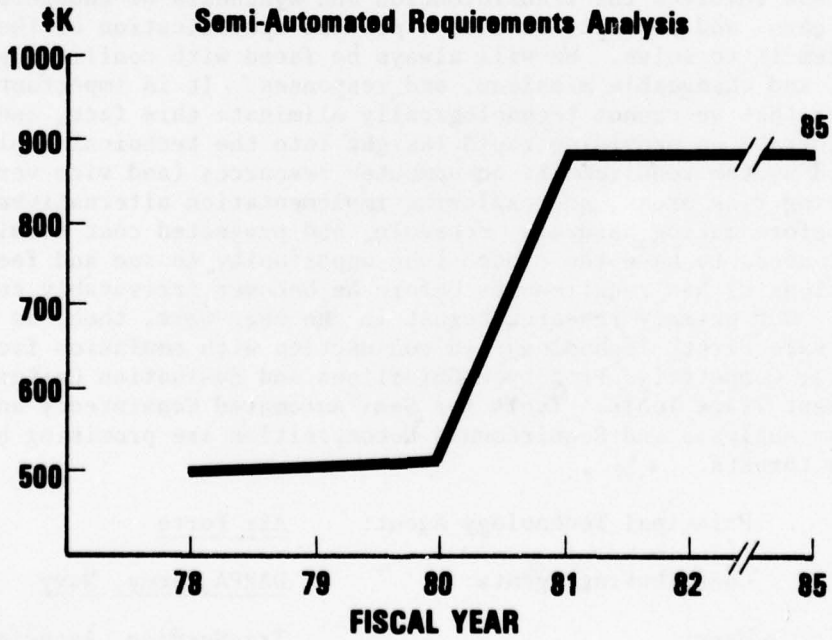
Principal Technology Agent:	Air Force
Contributing Agents:	DARPA, Army, Navy
User:	Tri-Service, Agencies
Technology Evaluator:	DARPA

III. BUDGET PROFILE

a. Exploratory/Advanced Development



b. Basic Research



A2. LIFE CYCLE MANAGEMENT PLANNING TECHNOLOGY

I. Problem/Issue Summary

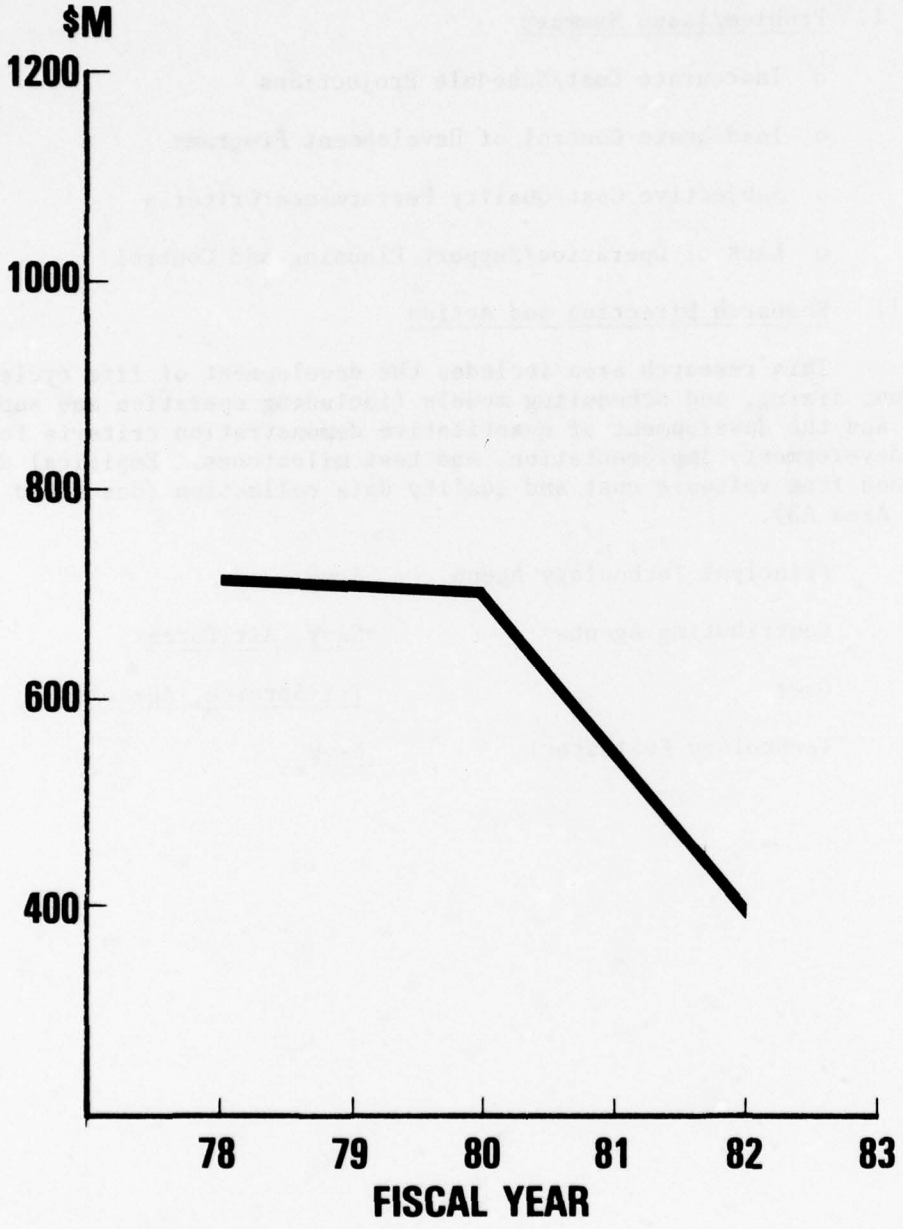
- o Inaccurate Cost/Schedule Projections
- o Inadequate Control of Development Programs
- o Subjective Cost/Quality Performance Criteria
- o Lack of Operation/Support Planning and Control

II. Research Direction and Action

This research area includes the development of life cycle cost estimation, sizing, and scheduling models (including operation and support phases), and the development of quantitative demonstration criteria for design, development, implementation, and test milestones. Empirical data is obtained from software cost and quality data collection (described under Research Area A3).

Principal Technology Agent:	Army
Contributing Agents:	Navy, Air Force
User:	Tri-Service, Agencies
Technology Evaluator:	Navy

III. BUDGET PROFILE



A3. COST/QUALITY DATA COLLECTION AND ANALYSIS

I. Problem/Issue Summary

- o Lack of Quantitative Cost/Quality Metrics
- o Lack of Information Base for Decisions
- o Inability to Compare Alternatives
- o Inability to Conduct Life Cycle Cost Tradeoffs

II. Research Direction and Action

This research area is directed toward collecting quantitative cost and quality data from ongoing systems (of all Services) and using it to gain insight into the quantitative relationship between numerous influence factors and relative cost and quality metrics. These relationships in turn will be used to define design constraints, and to guide test and evaluation strategy. Quantitative understanding of quality factors and cost drivers, and their relative importance to various sytem categories (e.g., avionics, C^3 weapon systems) is, has been, and will continue to be used to focus policy and program management action.

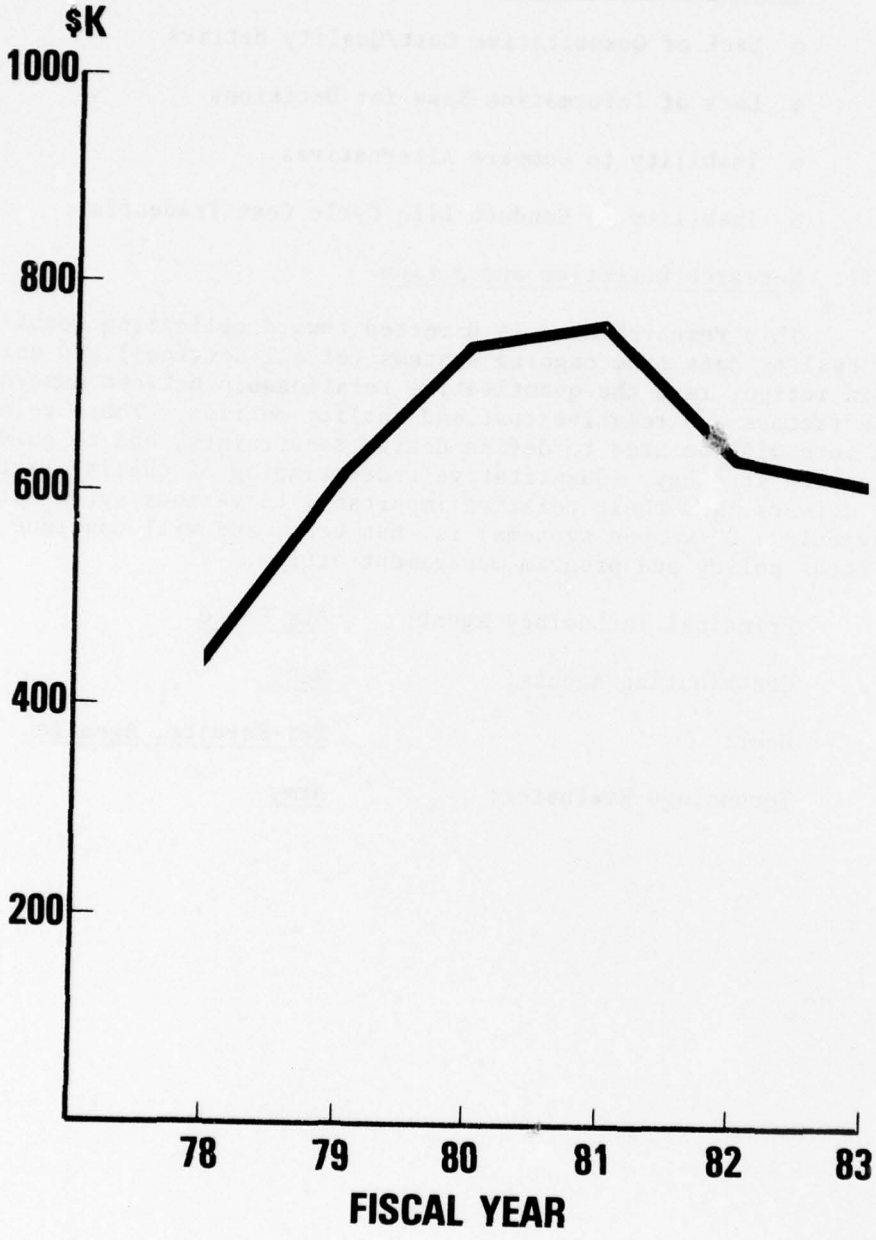
Principal Technology Agent: Air Force

Contributing Agents: Navy

User: Tri-Service, Agencies

Technology Evaluator: Army

III. BUDGET PROFILE



A4. MANAGEMENT CONTROL TECHNOLOGY

I. Problem/Issue Summary

- o Inadequate Interface Management
- o Inadequate Documentation
- o Inconsistent Application of Configuration Item Control and Accounting Procedures
- o Management Prerogatives Pre-empted
- o Inadequate Cost/Quality Traceability
- o Non-rigorous Change Control

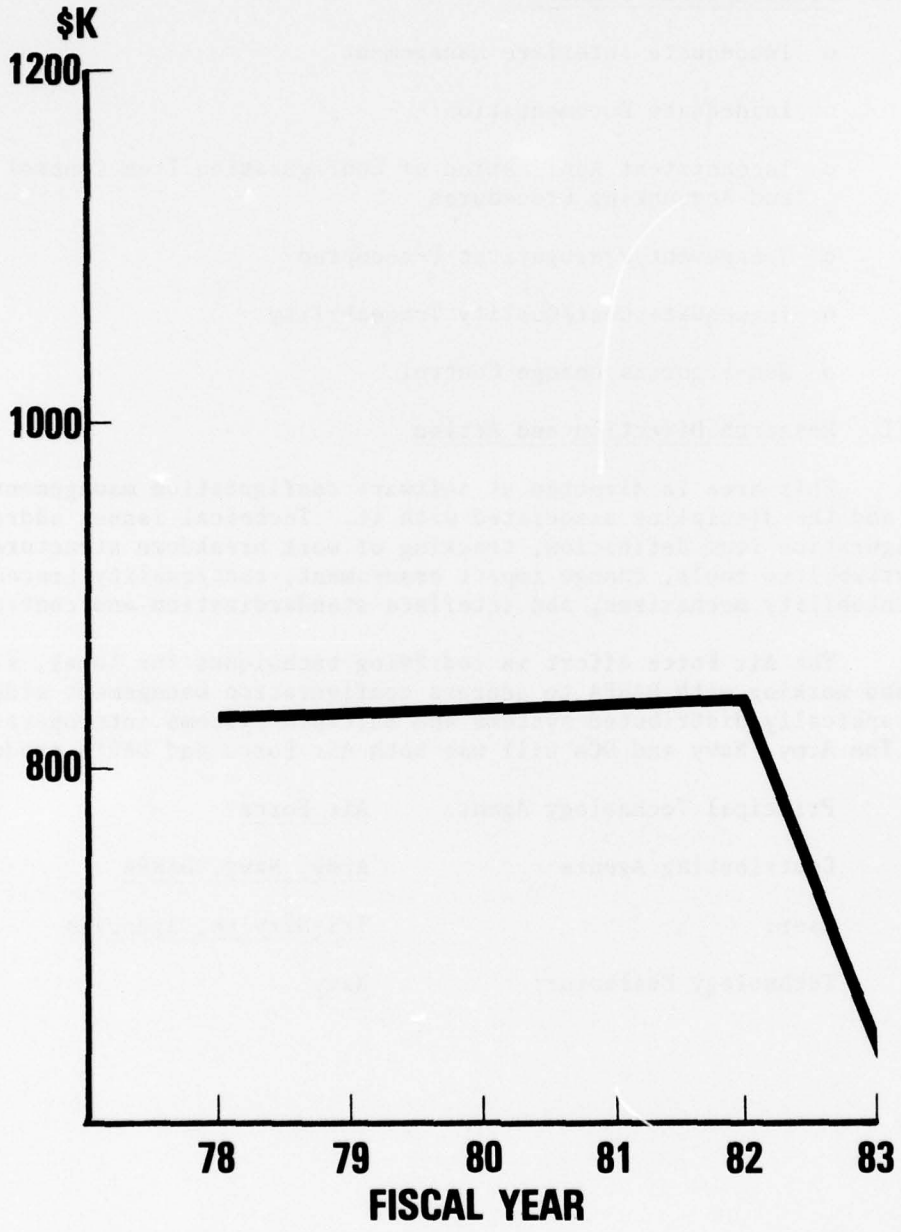
II. Research Direction and Action

This area is directed at software configuration management and control, and the discipline associated with it. Technical issues addressed are configuration item definition, tracking of work breakdown structures, desired visibility tools, change impact assessment, cost/quality traceability and accountability mechanisms, and interface standardization and control.

The Air Force effort is codifying techniques for local, single systems and working with DARPA to address configuration management aids for geographically distributed systems and multiple systems interoperability. The Army, Navy and DCA will use both Air Force and DARPA products.

Principal Technology Agent:	Air Force
Contributing Agents:	Army, Navy, DARPA
User:	Tri-Service, Agencies
Technology Evaluator:	Navy

III. BUDGET PROFILE



A5. POLICY AND PROCEDURE GUIDANCE

I. Problem/Issue Summary

- o Insufficient Understanding by Managers
- o Lack of Planning and Operation Guidance in Day-to-Day Operations
- o Lack of Systems Engineering Methodology and Discipline
- o Lack of Technology Transfer Into Application Domain
- o Lack of Personnel Skill Continuity Over Life Cycle

II. Research Direction and Action

This is perhaps the single most important research program underway at the present time because it represents the principal bridge between the research community and the day-to-day world of program managers, system project offices, and contracting officials. The core is a set of software acquisition management guidebooks which provide a collection of "lessons learned," and implications of decision options and alternatives. Seven guidebooks have already been published and ten more are under development. The content of the guidebooks is an important product, but the transfer of ideas and experience is the real payoff. These guidebooks are also being used in our personnel development and training initiatives. Subjects covered are: Regulations, Specifications, and Standards; Contracting for Software Acquisition; Monitoring and Reporting Software Development Status; Statement of Work Preparation; Reviews and Audits; Configuration Management; Requirements Specification; Software Documentation Requirements; Verification; Validation and Certification; Software Maintenance; Software Quality Assurance; Software Cost Estimating and Measuring; Software Development and Maintenance Facilities; Life Cycle Events; and Series Overview.

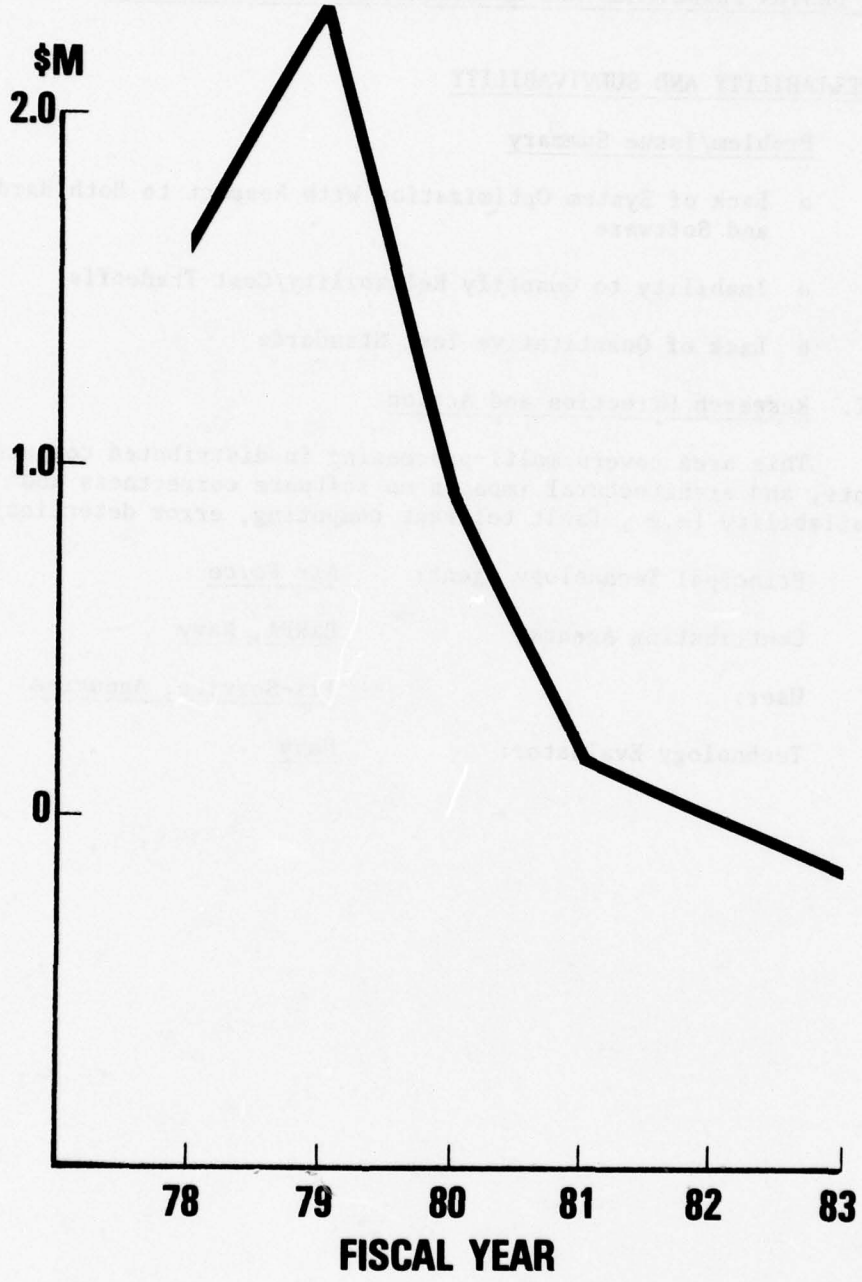
Future technology developments in other research areas will be transitioned to Program Managers using the guidebook series as a partial vehicle.

In addition to the guidebooks, DoD and Military Department standards and specifications are being revised to properly manage and control the software product as we now see it. DoDD 5000.1, 5000.2, 5000.3, MIL-STD-881B, MIL-S-52779, AFR 800.14, NAVAIR INST. 5230.5 are a few of the outgrowths of this work.

Workload has been divided among the three Services, with OSD contributing in its own area of cognizance (i.e., Computer Resources and the DSARC Process - Issue Checklist). The Air Force has responsibility for the guidebook program (avionics, C^3, and aerospace mission domains); Army and Navy have efforts to adopt the products, and to promote their use in the respective Services. Additionally, results from other research areas are provided by Army and Navy for inclusion under appropriate guidebook topics.

Principal Technology Agent:	Air Force
Contributing Agents:	Navy, Army, OSD, Agencies
User:	Tri-Service, Agencies, OSD
Program Evaluator:	OSD

III. BUDGET PROFILE



B. SYSTEM DESIGN PRINCIPALS AND ARCHITECTURAL STANDARDIZATION

B1. RELIABILITY AND SURVIVABILITY

I. Problem/Issue Summary

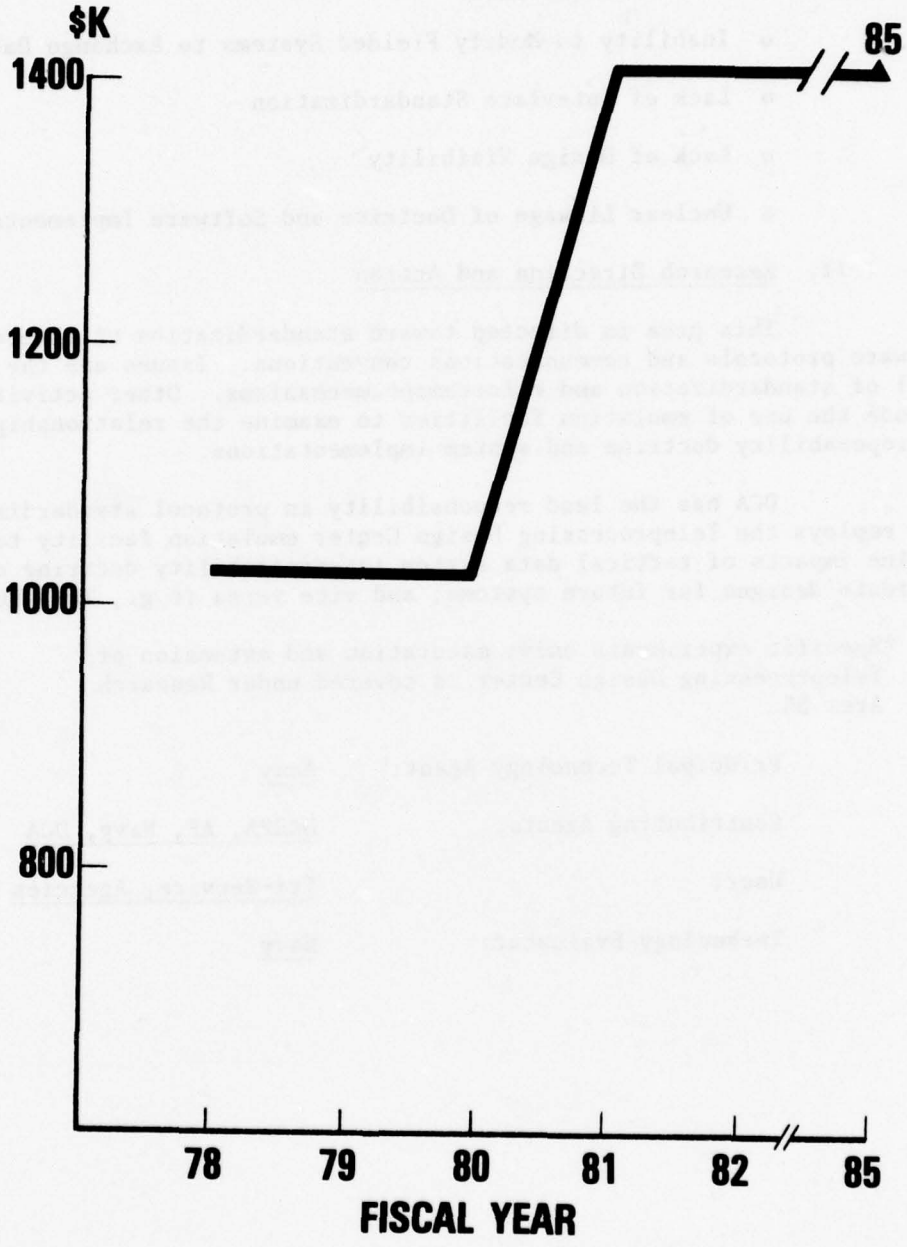
- Lack of System Optimization With Respect to Both Hardware and Software
- Inability to Quantify Reliability/Cost Tradeoffs
- Lack of Quantitative Test Standards

II. Research Direction and Action

This area covers multi-processing in distributed computing environments, and architectural impacts on software correctness and system availability (e.g., fault tolerant computing, error detection).

Principal Technology Agent:	Air Force
Contributing Agents:	DARPA, Navy
User:	Tri-Service, Agencies
Technology Evaluator:	Navy

III. BUDGET PROFILE



B2. INTEROPERABILITY

I. Problem/Issue Summary

- o Inability to Modify Fielded Systems to Exchange Data
- o Lack of Interface Standardization
- o Lack of Design Visibility
- o Unclear Linkage of Doctrine and Software Implementation

II. Research Direction and Action

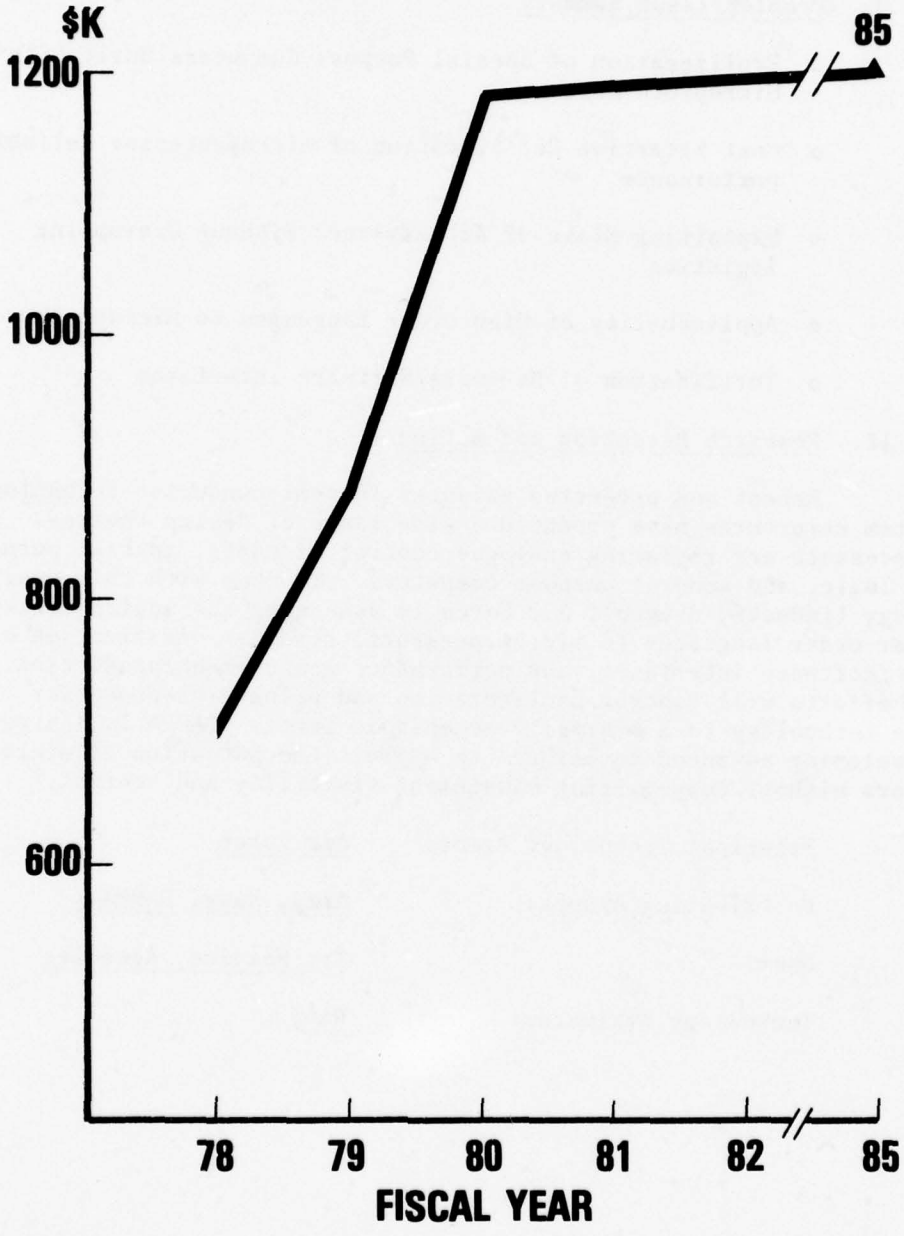
This area is directed toward standardization of intercomputer software protocols and communications conventions. Issues are the proper level of standardization and enforcement mechanisms. Other activities include the use of emulation facilities to examine the relationship between interoperability doctrine and system implementations.

DCA has the lead responsibility in protocol standardization. Army employs the Teleprocessing Design Center emulation facility to examine impacts of tactical data system interoperability doctrine on candidate designs for future systems; and vice versa (e.g., TACFIRETOS).*

*Specific experiments only; maturation and extension of Teleprocessing Design Center is covered under Research Area B5.

Principal Technology Agent:	Army
Contributing Agents:	DARPA, AF, Navy, DCA
User:	Tri-Service, Agencies
Technology Evaluator:	Navy

III. BUDGET PROFILE



B3. HARDWARE/SOFTWARE/FIRMWARE TRADEOFFS

I. Problem/Issue Summary

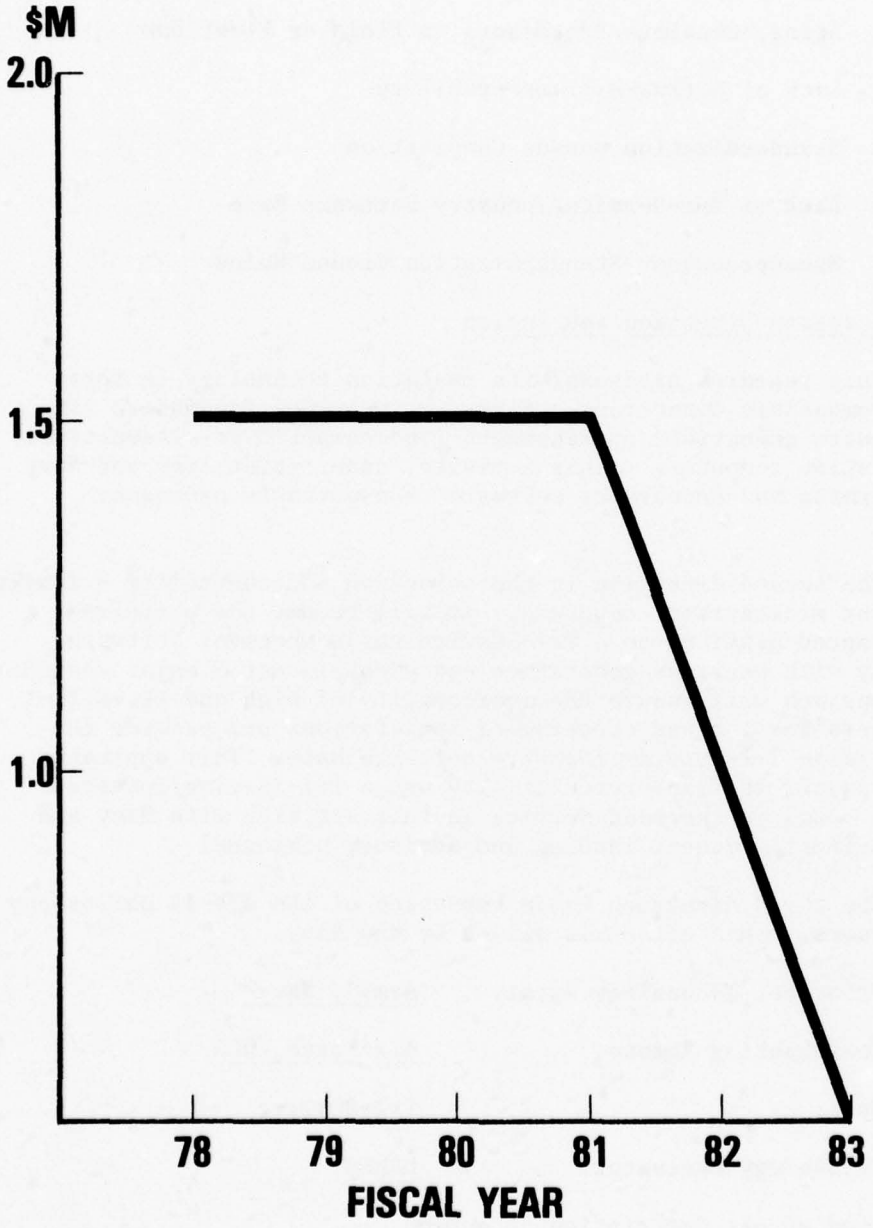
- o Proliferation of Special Purpose Computers Built with Microprocessors
- o Cost Effective Certification of Microprocessor Reliability/ performance
- o Exploiting State of Art Advances Without Disrupting logistics
- o Applicability of High Order Languages to Microprocessors
- o Verification of Hardware/Software Interfaces

II. Research Direction and Action

Recent and projected advances in semi-conductor technology and system structures have produced a wide range of design choices. Microprocessors are replacing analogue control circuits, special purpose digital logic, and general purpose computers. To cope with this evolving technology (industry driven), Air Force is assessing the applicability of higher order languages to microprocessors, studying verification of hardware/software interfaces, and performance measurement/prediction. Service efforts will control proliferation and bring microprocessor software technology to a minimally acceptable level. DARPA is charged with developing advanced techniques to exploit the potention of micro-processors without compromising management visibility and control.

Principal Technology Agent:	Air Force
Contributing Agents:	Army, Navy, DARPA
User:	Tri-Service, Agencies
Technology Evaluator:	Navy

III. BUDGET PROFILE



B4. COMPUTER ARCHITECTURE STANDARDIZATION AND COMMONALITY

I. Problem/Issue Summary

- o Aging, Obsolete Processors in Field or Fleet Use
- o Lack of Software Transferability
- o Standardization versus Competition
- o Lack of Tri-Service/Industry Software Base
- o Microprocessor Standardization Ground Rules

II. Research Direction and Action

This research area exploits emulation technology in three separate but compatible directions. First, it provides for modern computers as software compatible replacements (and competitive alternatives) to prior generation computers. This activity, under joint Army and Navy cognizance, permits and encourages software transportable processor modernization.

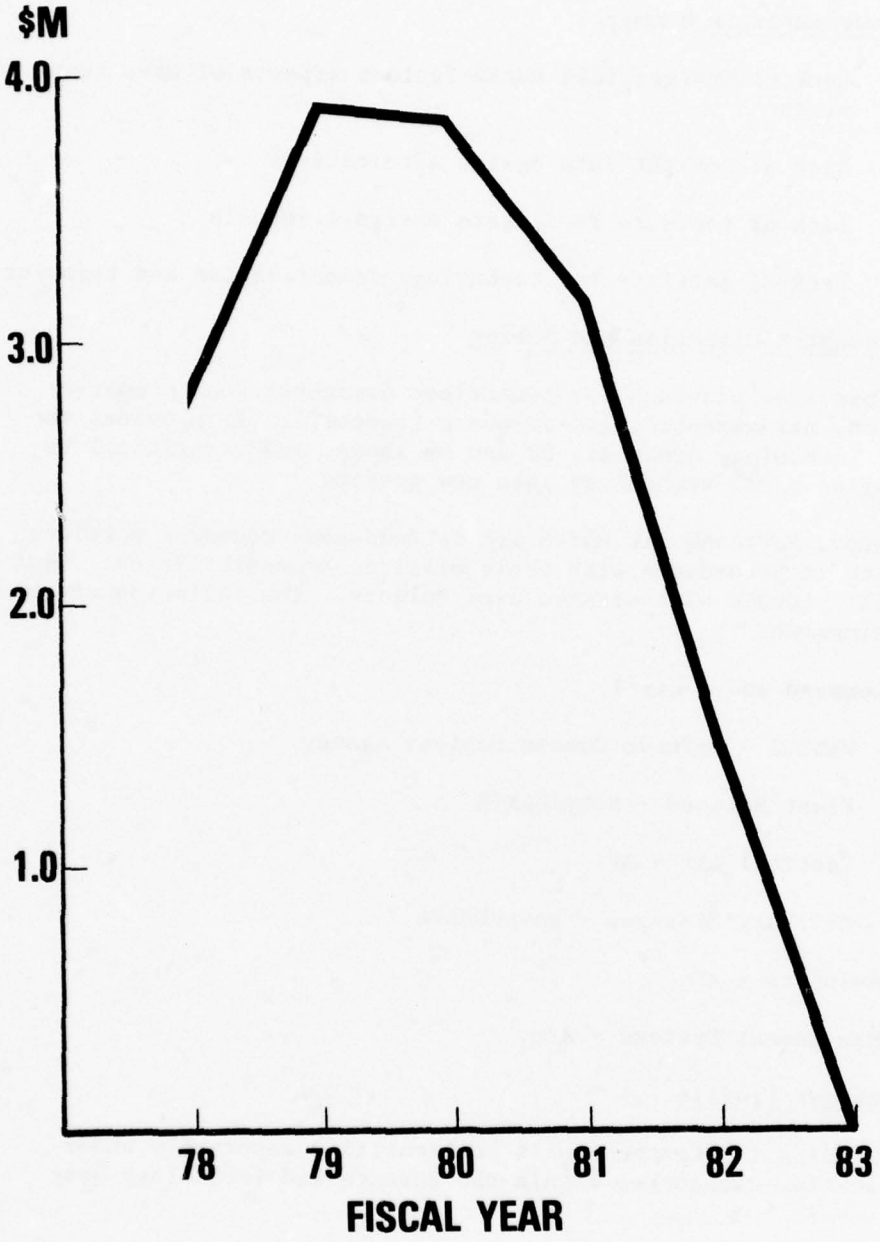
The second direction is the selection and control of a family architecture for militarized computers. It will become the preferred choice for advanced missions on a Tri-Service basis whenever software transferability with previous generation equipment is not a major consideration. This approach will insure the availability of high quality militarized computers for a broad spectrum of applications and provide the benefits of a large Tri-Service/industry software base. This approach will have its payoff in Tri-Service utility and a Tri-Service/industry software base. Army is the lead Service in this activity with Navy and Air Force contributing modest funding and advisory personnel.

The third direction is an extension of the AYK-14 philosophy to microprocessors. This effort is driven by the Navy.

Principal Technology Agent:	Army*, Navy*
Contributing Agents:	Air Force, DCA
User:	Tri-Service
Technology Evaluator:	DARPA

*Distributed as per description of action.

III. BUDGET PROFILE



B5. TESTBEDS

I. Problem/Issue Summary

- o Lack of insight into human factors aspects of user requirements
- o Lack of insight into design alternatives
- o Lack of tools to facilitate design tradeoffs
- o Lack of facility for technology demonstration and transfer

II. Research Direction and Action

This area provides for technology demonstrations, requirements validation, hardware-software-firmware tradeoffs. It provides the foundation for Technology Areas A1, B2 and B4 above, and is critical to the transfer of advanced technology into new systems.

Army, Navy and Air Force are to fund non-redundant portions of this activity in accordance with their mission responsibilities. Testbeds are normally funded with mission area dollars. The following testbeds are under development:

Command and Control:

WWMCCS - Defense Communications Agency

Fleet Related - Navy/DARPA

Tactical Air - AF

Military Messages - Navy/DARPA

Avionics - AF

Management Systems - Army

III. Budget Profile

Funding for testbeds will be identified seperately under specific application categories within the Science and Technology Base.

C. IMPLEMENTATION AND MAINTENANCE ENVIRONMENT

C1. FORMAL METHODS OF SOFTWARE VERIFICATION AND MAINTENANCE

I. Problem/Issue Summary

- Software Verification/Validation and Certification Difficulty
- Impossibility of Exhaustive Testing

II. Research Direction and Action

These efforts aim to demonstrate tools for formally proving that programs correctly implement specifications. Initially, the tools will be used to fully verify critical modules in such applications as multi-level security, communications, and data management. DARPA has the lead in this technology area. The Air Force will begin trial applications during FY78.

Principal Technology Agent:	DARPA
Contributing Agents:	Army, Navy, Air Force
User:	Tri-Service/Agencies
Technology Evaluator:	Navy

III. BUDGET PROFILE

C2. SOFTWARE ENGINEERING TOOLS AND METHODS

I. Problem/Issue Summary

- Lack of language standardization and control
- Lack of state of the art tools for military computers and programming languages
- Lack of transferability of tools from one project to the next
- Lack of rigor and discipline in software development/ maintenance
- Lack of management control and visibility
- Lack of explicit decision process for introducing new technology

II. Research Direction and Action

Industry has developed tools and methodologies that can significantly improve the software development process including design, coding, testing, and maintenance. Unfortunately, the tools available for DoD languages and militarized computers have generally been lower quality than those available for the most popular computers in the commercial marketplace. A comprehensive intergrated set of tools and methodologies should be available for use on all major DoD software acquisitions regardless of prime contractor. The tools and methods included are:

Top Down Design and Structured Programming Methods
System Design Languages
Structured Code Preprocessors and Analyzers
Program Development Support Libraries
Automated Code Verification Tools
Software Test Case Generators
Automated Compiler Generators
Compiler Validators

This research area has four main thrusts:

- Control and support of approved high order languages and compilers.
- Evaluations and language development aimed at exploiting state-of-the-art advances in language design and at eliminating obsolete languages from the approved list.

o Development/collection of integrated systems of tools for DoD languages, computers, and applications, including evaluations of the effectiveness, availability, transferability, and maintenance/control requirements of such tools. DoD applications for which programming environments are being configured include the following: WWMCCS, PAVE PAWS, AFSAMTECH, Army TACPOL systems and COBOL systems, Navy CMS-2 systems, and avionics systems written in JOVIAL.

o Development of a distribution mechanism to provide access to software tools via an existing and widely available communications network. This distribution system will also facilitate the operational evaluation of new tools, methods, and languages.

Principal Technology Agent:

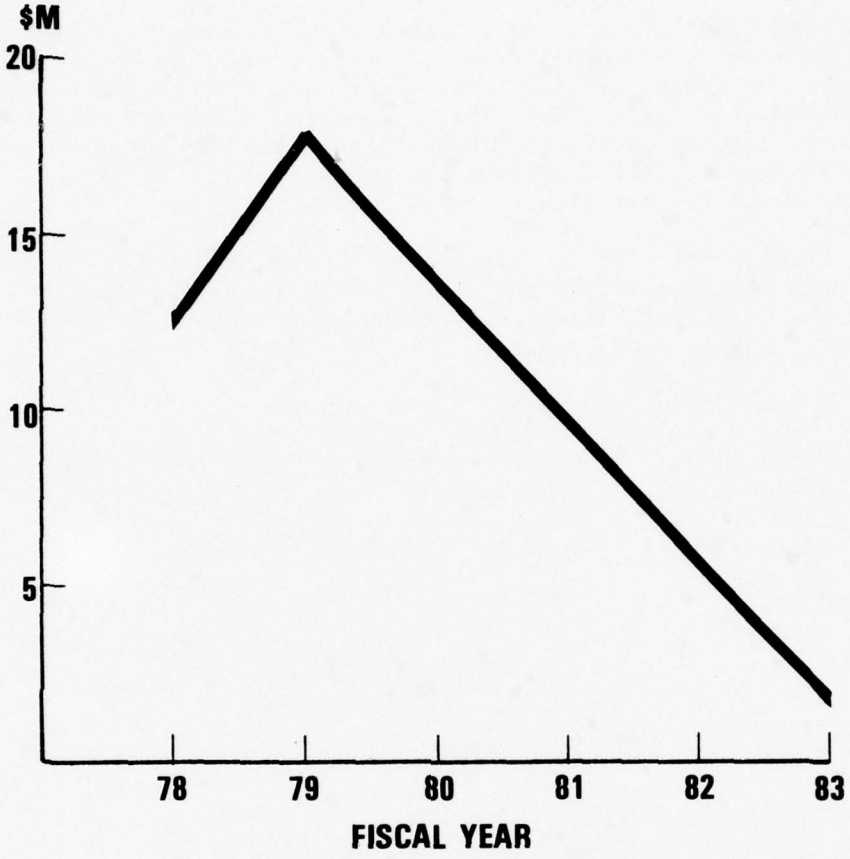
JOVIAL J73	Air Force
JOVIAL J3	Air Force
CMS-2	Navy
SPL/1	Navy
TACPOL	Army
COBOL	OSD(C)
FORTRAN	OSD(C)

Contributing Agents: DARPA

User: Tri-Service, Agencies

Technology Evaluator: Users

III. BUDGET PROFILE*



* TOPICAL BREAKDOWN - APPROXIMATE

LANGUAGE SUPPORT AND CONTROL (INTERIM STANDARDS)	29%
LANGUAGE MODERNIZATION AND CONVERGENCE	13%
PROGRAMMING ENVIRONMENTS	24%
TOOL DISTRIBUTION	23%
QUALITY METRICS AND T/E STANDARDS	11%

PART TWO

PROGRAM MANAGEMENT

- o General
- o Principal Technology Agent
- o Contributing Agents
- o Research Area Evaluator
- o Fiscal Implementation
- o PTA and RAE Designation

A. GENERAL

The Director of Defense Research and Engineering is responsible for the execution of the Defense System Software Research and Development Technology Plan. To assist in executing this responsibility, an R&D Technology Panel reporting to the Management Steering Committee for embedded Computer Resources has been established. The Panel will maintain this plan, and monitor the progress of technology initiatives. There will be a Principal Technology Agent (PTA), Contributing Technology Agents (CTA), and a Research Area Evaluator (RAE) for each technology area, insuring a coordinated approach to meeting the technology objectives These organizational relationships are summarized in Figure II-1. The responsibilities of the PTA, CTA, and RAE are discussed below.

B. ROLE OF THE PRINCIPAL TECHNOLOGY AGENT

In order to provide an identifiable, accessible, and up-to-date authority on each of the twelve research areas, the concept of a Principal Technology Agent has evolved.

The Principal Technology Agent is to be selected by the designated Component, whereupon it will assume the responsibility of Area Coordination for all activity which takes place in any Military Department or Defense Agency, and which is pertinent to the designated research area. PTA responsibilities include:

- Maintain general excellence in the research area,
- Provide advice and consultation to DoD Component on matters related to the research area,
- Be knowledgeable about current state of art including awareness of reports, software products, and personnel contacts pertinent to the research area,
- Sponsor planning meetings to coordinate work in the area,
- Generate progress reports on research area status to the MSC-ECR via the R&D Technology Panel, and issue an annual report (10 pages maximum) during the month of September, and
- Publicize significant activities and results emerging from the research area.

The PTA shall maintain close continued contact with the R&D Technology Panel, the MSC-ECR, and the research area evaluator to discuss progress, concerns, future plans, and recommendations.

C. ROLE OF CONTRIBUTING TECHNOLOGY AGENTS

Contributing Technology Agents should have on-going thrusts which complement the efforts of the PTA. These should pursue alternate technical approaches, possibly being longer-term higher risk, or they should address a different set of DoD applications. CTA are required to keep the PTA informed of work proposed, work in progress and accomplishments for inclusion in the technology area annual report.

D. ROLE OF RESEARCH AREA EVALUATOR

To introduce independent, unbiased, and constructive criticism, a Research Area Evaluator has been designated for each of the twelve research areas.

The RAE organization is to be selected by the appropriate Military Department. It has two main functions. The first is to recommend whether a new technique or tool is ready for transition to the next stage of development. The second is to identify gaps in the coverage of research area problems. In other words, the evaluator should focus attention on problems which will not be solved even if all on-going research thrusts are successful.

Under no circumstances shall the RAE have veto or redirection power over projects conducted by the Military Departments or Defense Agencies. Instead, his function is to provide constructive critical comments and appraisals to the MSC-ECR and its panels, to the PTA, and to the research proponents. The RAE shall not attempt nor shall he be called upon to prejudice any other sector of the management or research communities with respect to product validity, strengths, or limitations.

The responsibilities, then of the RAE are to:

- Advise the MSC-ECR and its panels, the PTA and the research proponent as to the balance and progress of research thrusts in the area
- Collaborate with the PTA on the preparation of the year end research area status report. Provide a list of accomplishments for the previous year
- Maintain general excellence in research area, and developments in DoD and industry which affect it.

E. FISCAL IMPLEMENTATION

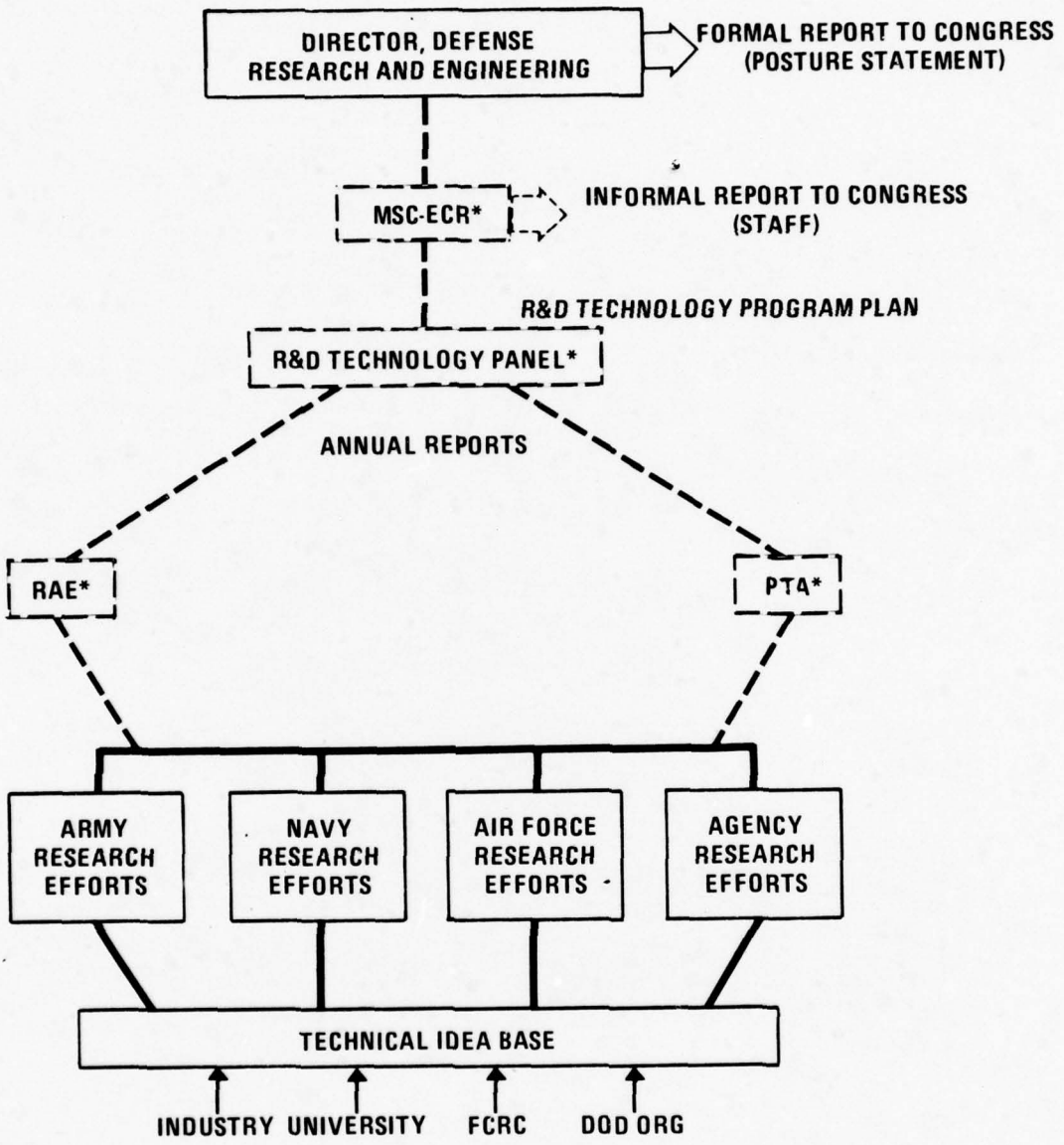
Funds to execute the provisions of this document are to be identified within the following program elements:

PE	62701A	Communications, Electronics
PE	62725A	Computer Sciences
PE	62721N	Command and Control Technology
PE	62702F	Rome Air Development Center Manning and Communications Electronics
PE	62204F	Advanced Avionics
PE	62706E	Distributed Information Systems
PE	63703A	Automatic Data Processing Equipment Development
PE	63526N	Advanced Computer Technology
PE	63728F	Advanced Computer Technology
PE	64501N	Computer Systems Engineering Development
PE	64740F	Application of Information Processing Technology

F. PTA AND RAE DESIGNATION

Research Area	PTA	RAE
I	Air Force	DARPA
II	Army	Navy
III	Air Force	Army
IV	Air Force	Navy
V	Air Force	OSD
VI	Air Force	Navy
VII	Army	Navy
VIII	Air Force	Navy
IX	Army	DARPA
X	ALL	Mission Area Sponsors
XI	DARPA	Navy
XII		
CMS-2	Navy	Users
SPL-1	Navy	"
TACPOL	Army	"
J73	Air Force	"
J3	Air Force	"
COBOL	OASD(C)	"
FORTRAN	OASD(C)	"

FIGURE II-1



*DOTTED LINES INDICATE COORDINATING ORGANIZATIONS

ANNEX A

SOFTWARE SCIENCE AND TECHNOLOGY BASE TECHNOLOGY OBJECTIVES

adopted by the

Management Steering Committee for Embedded Computer Resources

31 August 1976

SOFTWARE SCIENCE AND TECHNOLOGY BASE

APPROVED TECHNOLOGY OBJECTIVES

The Military Departments, through the Research and Development Technology Panel to the Management Steering Committee for Embedded Computer Resources (MSC-ECR), have formulated broad technology objectives for evaluating the software technology base. These objectives reflect current deficiencies in both embedded and general purpose computer application areas. The objectives were proposed to the MSC-ECR and subsequently adopted (with minor changes) in September 1976. The technical objectives as adopted are itemized below. No efforts to prioritize among the objectives have been made.

1. Project Management:

    1.1 Resolve technical issues associated with the preparation of life cycle computer resources.

    1.2 Develop improved methods and tools for planning, estimating and controlling software development.

    1.3 Develop criteria and procedures for configuration item definition, interface definition and control, and change control and impact assessment of changes.

    1.4 Develop methods, languages and tools for describing and validating requirements.

    1.5 Establish risk analysis techniques to minimize unforeseen cost and schedule impacts from system requirements.

    1.6 Develop qualitative and quantitative measures of software quality.

    1.7 Establish a uniform software error and cost data collection and analysis methodology.

    1.8 Perform computer technology assessments and develop techniques for measuring the impact of software technology advances on productivity.

    1.9 Demonstrate new technology concepts through prototype or experimental proofing prior to full scale technology transfer to on-going system applications.

2. System Architecture

    2.1 Develop concepts in computer system architecture which reduce software costs, improve timeliness, increase quality, and/or enhance man-maching interaction.

2.2 Develop software techniques which increase the usefulness of computer architectures.

2.3 Develop methods for designing computer systems which explicitly consider the trade-offs between hardware, software and firmware.

2.4 Develop and demonstrate techniques and concepts to ensure security of information systems.

2.5 Demonstrate techniques for flexible, interoperable, and reliable data management systems.

3. Programming Environment

3.1 Identify properties of programming languages and compilers which provide for effective control of software development, enhanced quality, and reduced cost.

3.2 Develop tools which automate the clerical aspects of software design and synthesis.

3.3 Develop methods and tools for testing which allow determination of whether adherence to the requirements has been achieved within a stated tolerance, or which otherwise quantify reliability.

3.4 Develop techniques and supporting tools for proving that programs and specifications are consistent.

3.5 Demonstrate techniques and tools which enhance the maintainability and modifiability of software.

3.6 Demonstrate techniques and tools for software transportability which significantly reduce the effort to modify software so it will execute on different computer hardware.

3.7 Develop software engineering methods which exploit new tools to improve the quality of software and provide for effective control of development.

3.8 Develop programming environments to facilitate the flexible use of many tools in combination with each other, and the addition of new tools.

4. Reusable Software and Tool Availability

4.1 Develop techniqes for formal specification of standard software products.

4.2 Develop technology for adapting standard software products to specific applications, and for cost effectively maintaining the resultant product families.

4.3 Demonstrate techniques for efficiently transporting standard products to different hardware.

4.4 Establish language control facilities and develop necessary supporting tools.

4.5 Eliminate the need to build new versions of software tools just to make them available for new languages and different computer systems.

4.6 Establish easily accessible repositories and distribution systems for software tools and other reusable software.

4.7 Investigate the consolidation of the many HOLS in common use to a smaller number of common HOLS.

ANNEX B

CHARTER FOR THE R&D TECHNOLOGY PANEL

adopted by the

Management Steering Committee for Embedded Computer Resources

29 October 1976

MEMORANDUM OF UNDERSTANDING

The Department of Defense Automation Objectives dated March 25, 1976 included an initiative to "outline a program of applied research requirements." The intent of this particular initiative was to establish a formal process that would provide for the production of a coordinated set of R&D objectives and supporting projects to accomplish these objectives in the area of general purpose data processing.

Similarly, during the same period of time DoD Directive 5000.29, dated April 26, 1976, established a mechanism for resolving many problems associated with the management of computer resources in major Defense systems. In addition to addressing other problems, the Management Steering Committee for Embedded Computer Resources (MSC-ECR) established the need for a coordinated approach to solving the R&D problems associated with computer resources in major Defense systems (i.e., embedded computers). Hence, the R&D Coordinating Panel was one of the four panels to be established under the MSC-ECR.

The computer science problems that plague the general purpose area are very similar to those that plague the area of embedded computers. Therefore, a single panel supporting both communities seems highly appropriate. Moreover, since the ODDR&E must review the computer science R&D of both communities this panel would provide the proper mechanism for establishing and maintaining a unified and cohesive R&D program. Hence, panel efforts would be supported by both the ADP Policy Committee representing the general purpose area and the MSC-ECR representing the area of embedded computers.

An approved charter for this panel is attached.

Representing Embedded Computer Systems Area

OASD(I&L) Barry DeRoze

Representing General Purpose ADP Area

OASD(C) John Carabello

ODDR&E Tom Nyman

CHARTER

FOR THE

RESEARCH AND DEVELOPMENT TECHNOLOGY PANEL

1.0 OBJECTIVES

The objectives of the Research and Development Technology Panel (RDTP) are to:

a) provide a coordinated research and development program plan to supply the technology base which supports all computer resource applications within DoD;

b) provide recommendations and advice to both the Management Steering Committee for Embedded Computer Resources and the ADP Policy Committee to avoid unproductive overlap, gaps, or duplication of effort in the conduct of DoD's computer resources research and development efforts;

c) formulate and as necessary propose additions and deletions to computer resource R&D objectives for joint consideration by the MSC-ECR and the ADP Policy Committee;

d) serve as a forum for coordinating technology investment strategy for the Military Departments and Defense Agencies;

e) review R&D programs to monitor progress toward established objectives; provide annual progress appraisal against each established objective, jointly to the MSC-ECR and ADP Policy Committee;

f) identify technologies which appear ready for operational use, and assist the MSC-ECR, DDR&E and the ADP Policy Committee in conducting and evaluating suitable demonstrations;

g) provide technical comments on Technology Annexes to DCPs and PMs as requested by the MSC-ECR.

h) assist Program Managers and System Project Offices in the identification of technology deficient areas and in promoting technology transfer.

In pursuing the above objectives, the scope of the RDTP will encompass all computer resource research and development activities within the Military Departments and Defense Agencies, and will include both embedded computer resources and general purpose automatic data processing application areas.

2.0 REFERENCE

The RDTP functions in accord with the policies of DoD Directive 5000.29, "Management of Computer Resources in Major Defense Systems," 26 April 1976 and DoD Directive 5100.40, "Responsibilities for the Administration of the DoD ADP Program," 19 August 1975.

3.0 CHAIRMANSHIP

The RDTP shall have a permanent Chairman selected by, and representing the Director, Defense Research and Engineering. The Chairman will be the responsible spokesman for the RDTP, and will administer the Panel affairs.

4.0 MEMBERSHIP

The membership of the RDTP shall be composed of not more than three representatives from each Military Department and Defense Agency. Members of the RDTP shall be selected by their respective DoD Component and their scope shall represent both embedded computer resources and general purpose automatic data processing application areas.

5.0 ACTIVITIES

In fulfilling the objectives of the Charter, the RDTP shall as a minimum carry out the following activities:

a) develop, propose, and maintain a DoD Computer Resource R&D Technology Program Plan

   1) develop computer resources technology objectives,

   2) identify current effort devoted to these objectives,

   3) identify and prioritize critical areas which need immediate emphasis,

   4) plan near, mid, and long term solutions to each objective,

5) identify and recommend responsible agency or joint activity to lead on areas of common interest,

6) identify resource implications of these efforts;

b) meet at least quarterly to discuss progress toward objectives;

c) prepare and present an annual report on R&D Technology Progress to a joint meeting of the MSC-ECR and the ADP Policy Committee.

d) Provide summary briefings on Panel activities at each formal meeting of the MSC-ECR;

e) carry out specific tasks as directed by the Chairman of the MSC-ECR and DDR&E. The Chairman of the ADP Policy Committee will request specific tasks through his participation on the MSC-ECR.

ANNEX C

BRIEFING CHARTS

DEFENSE SYSTEM SOFTWARE MANAGEMENT PROGRAM

SOFTWARE RESEARCH AND DEVELOPMENT TECHNOLOGY PROGRAM PLAN

2541-7

BACKGROUND

- **WE DO HAVE A SOFTWARE PROBLEM IN DOD**
  - ERRORS AND FAULTS
  - REDUNDANCY AND DUPLICATION OF EFFORT
  - DISSATISFIED USERS
  - EXPENSIVE

- **RESULT —** WE SPEND MONEY AND PEOPLE RESOURCES ON THE PROCESS DIVERTING CREATIVE THINKING AWAY FROM THE MISSION !!!

DoD DEFENSE SYSTEM
SOFTWARE MANAGEMENT PROGRAM

OBJECTIVE: TO DERIVE AND CARRY OUT A COMPREHENSIVE AND INTEGRATED SOLUTION TO THE PROBLEMS OF EMBEDDED COMPUTER SYSTEM RESOURCE ACQUISITION, MANAGEMENT, AND USE.

UNDERLYING THEMES ARE:

- DISCIPLINE AND RIGOR
- MANAGEMENT VISIBILITY
- COST CONTROL
- SCHEDULE CONTROL
- IMPROVED QUALITY

2541-7

MANAGEMENT STEPS

- AIMED AT MAKING DoD BETTER "CONSUMER"

OSD

- DEFENSE SYSTEM SOFTWARE MANAGEMENT PLAN
- DoD DIRECTIVE 5000.29
- DoD INSTRUCTION 5000.31
- MANAGEMENT STEERING COMMITTEE-EMBEDDED COMPUTER RESOURCES
- DEPUTY SECRETARY OF DEFENSE MEETINGS
- PERSONNEL DEVELOPMENT AND TRAINING STEPS

SERVICES

- AIR FORCE REGULATION 800-14 VOLUMES 1 AND 2
- AFSC SOFTWARE ENGINEERING MANAGEMENT PLAN
- AFSC COMPUTER RESOURCES TECHNOLOGY, ENGINEERING, AND MANAGEMENT PLAN
- NAVAIRINST 5230.5

-ETC.-

2541 7

SYSTEM ACTIONS

MAJOR, POSITIVE IMPACTS — LIFE CYCLE IMPROVEMENTS IN COST/QUALITY

- F-18 FLIGHT COMPUTER (AYK-14)
- B-1 ALTERNATIVE COMPUTER
- TACFIRE EMULATION (GYK-12)
- TELEPROCESSING DESIGN CENTER — INTEROPERABILITY
- ANTI-SHIP MISSILE DEFENSE-ELECTRONIC WARFARE
- B-1 OFFENSIVE AVIONICS
- AEGIS
- BMD SITE DEFENSE
- PATRIOT
- POSITION LOCATING AND REPORTING SYSTEM
- PAVE PAWS
- SHUTTLE — IUS

- OTHERS -

OTHER GENERIC ACTIONS

- STOPPED LANGUAGE PROLIFERATION
- ESTABLISHED CONTROL OF LANGUAGES
- QUANTITATIVE COST AND QUALITY DATA COLLECTION
- STANDARDIZATION WITH COMPETITION — DEMONSTRATED!

WE HAVE HAD SOME MAJOR SUCCESSES!!

BUT...

SOFTWARE
RESEARCH AND DEVELOPMENT
TECHNOLOGY

AN ACTIVE R&D EFFORT MUST UNDERLIE MANAGEMENT INITIATIVES...

WHERE THE ACTION IS IN

— SOFTWARE R&D —

- REQUIREMENTS ANALYSIS
- LIFE CYCLE MANAGEMENT PLANNING
- COST AND QUALITY DATA COLLECTION/ANALYSIS
- MANAGEMENT CONTROL TECHNOLOGY
- POLICY AND PROCEDURE GUIDANCE
- RELIABILITY AND SURVIVABILITY
- INTEROPERABILITY
- HARDWARE/SOFTWARE/FIRMWARE TRADE-OFFS
- COMPUTER ARCHITECTURE STANDARDIZATION
- TESTBEDS
- FORMAL METHODS FOR SOFTWARE VERIFICATION AND MAINTENANCE
- SOFTWARE ENGINEERING TOOLS AND METHODS

FY 78 SOFTWARE MANAGEMENT PROGRAM
THRESHOLD = $27.973 M

RESEARCH AREA DESCRIPTION

I. REQUIREMENTS ANALYSIS $877K (3.3%)

CONCENTRATION ON RAPID INSIGHT INTO IMPLICATIONS OF STATED REQUIREMENTS ON COMPUTER RESOURCES (AND VICE VERSA), IDENTIFYING RISK AREAS, AND ITERATIVELY EXPLORING IMPLEMENTATION ALTERNATIVES BEFORE HARDWARE, SCHEDULE, AND COST COMMITMENTS ARE MADE.

RESEARCH THRUST AT

- REQUIREMENTS DECOMPOSITION
- "SOFTWARE FIRST" TECHNOLOGY
- COMPETITIVE PROTOTYPE GUIDELINES/EVALUATION CRITERIA
- REQUIREMENT TRACE TOOLS
- SEMI-AUTOMATED CONSISTENCY/COMPLETENESS ANALYSIS

KEY POINTS

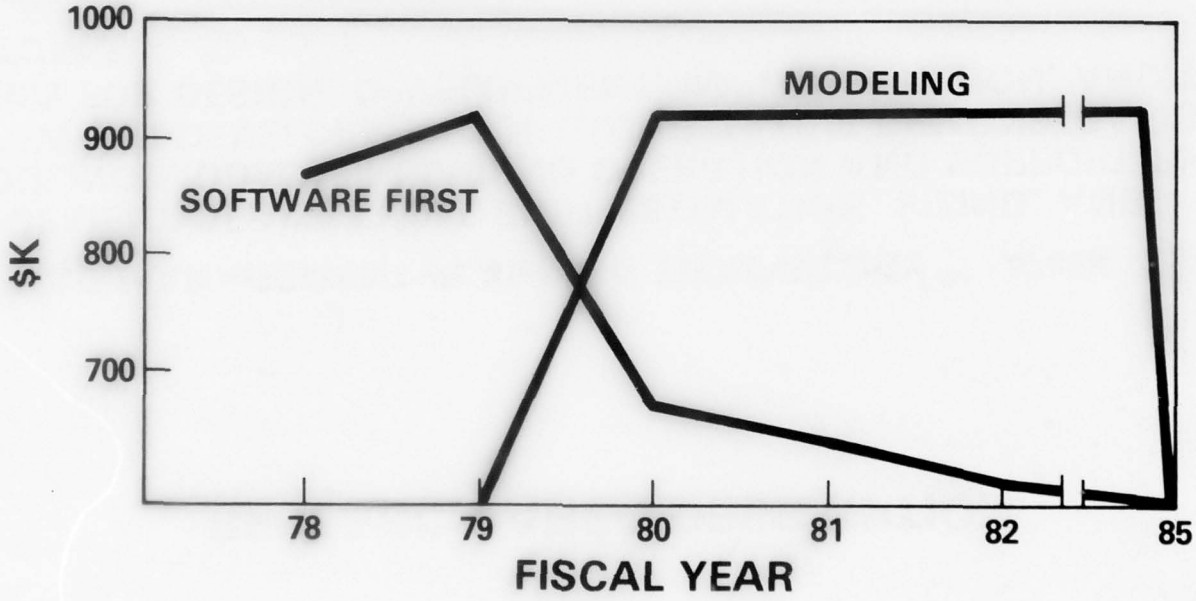
- RECOGNIZE LIMITATIONS – REQUIREMENTS FORMULATION IMPERFECT
- CONCENTRATES ON MAKING IMPLICATIONS VISIBLE
- CLOSES LOOP ON REQUIREMENTS BEFORE COMMITMENT (HARDWARE/SCHEDULE/COST)
- BASIS FOR CHANGE IMPACT ASSESSMENT

2541-7

FY 78 ACTIVITY

- AIR FORCE LED
- NAVY DEMONSTRATION OF AIR FORCE CONSISTENCY/ COMPLETENESS TOOL IN SHIPBOARD APPLICATION
- DARPA THRUST IN SEMI-AUTOMATED MODELING
- ARMY-NAVY USERS, TRANSFER AGENTS

BUDGET FORECAST



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RESEARCH AREA DESCRIPTION

II. LIFE CYCLE MANAGEMENT PLANNING TECHNOLOGY $749K (2.9%)

DEVELOPMENT OF LIFE CYCLE COST ESTIMATION, SIZING, AND SCHEDULING MODELS (INCLUDING OPERATION AND SUPPORT PHASES), AND TOWARD DEVELOPMENT OF QUANTITATIVE DEMONSTRATION CRITERIA FOR DESIGN, DEVELOPMENT, IMPLEMENTATION, AND TEST MILESTONES.

EMPIRICAL DATA IS OBTAINED FROM SOFTWARE COST AND QUALITY DATA COLLECTION (DESCRIBED UNDER RESEARCH AREA III).

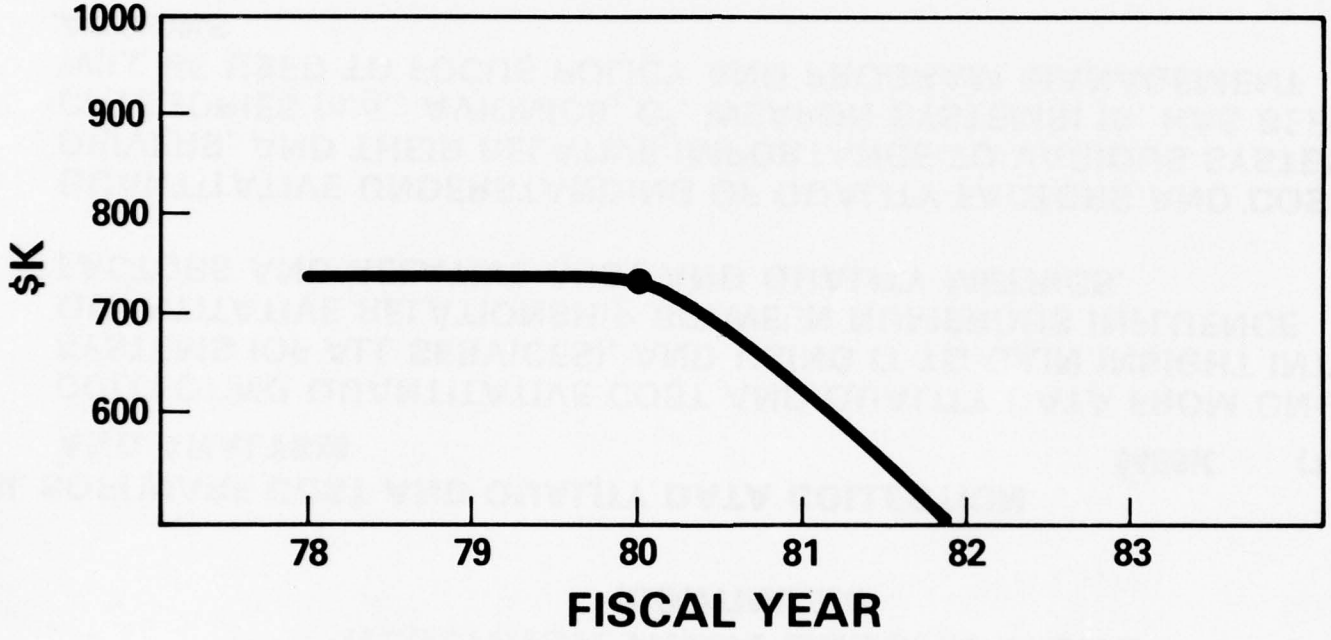
KEY POINTS

- METHODOLOGY ORIENTED
- LIFE CYCLE COST ESTIMATION AND SIZING
- QUANTITATIVE MILESTONE DEMONSTRATION CRITERIA

FY 78 ACTIVITY

- METHODOLOGICAL EFFORT BY ARMY
- EMPIRICAL DATA SUPPLIED BY AIR FORCE
- NAVY PARTICIPATES AS USER

BUDGET FORECAST



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RESEARCH AREA DESCRIPTIONS
(CONTINUED)

III. SOFTWARE COST AND QUALITY DATA COLLECTION AND ANALYSIS $456K (1.7%)

COLLECTING QUANTITATIVE COST AND QUALITY DATA FROM ONGOING SYSTEMS (OF ALL SERVICES), AND USING IT TO GAIN INSIGHT INTO THE QUANTITATIVE RELATIONSHIP BETWEEN NUMEROUS INFLUENCE FACTORS AND RELATIVE COST AND QUALITY METRICS.

QUANTITATIVE UNDERSTANDING OF QUALITY FACTORS AND COST DRIVERS, AND THEIR RELATIVE IMPORTANCE TO VARIOUS SYSTEM CATEGORIES (e.g., AVIONICS, C^3, WEAPON SYSTEMS) IS, HAS BEEN, AND WILL BE USED TO FOCUS POLICY AND PROGRAM MANAGEMENT ACTIONS.

KEY POINTS

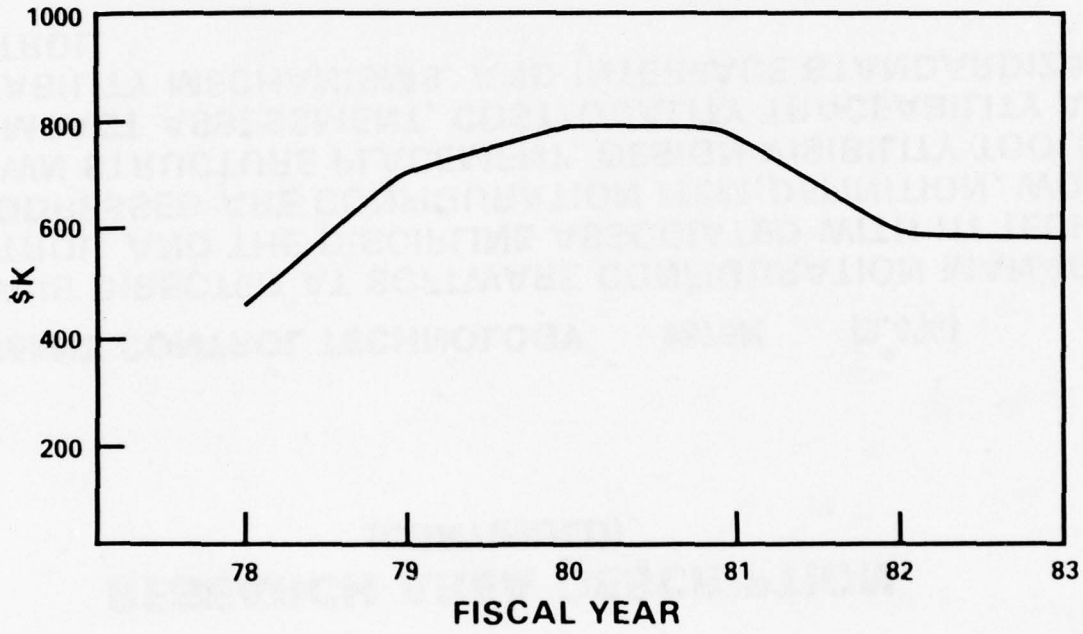
- ADDRESSES LACK OF QUANTITATIVE INSIGHT
- SUPPORTS
  - COST ESTIMATION/SIZING
  - DESIGN FOR RELIABILITY
  - TEST AND EVALUATION CRITERIA, STANDARDS, AND METRICS
  - TECHNOLOGY EVALUATION/SELECTION
- DEFINE POLICY LEVERAGE POINTS
- GUIDE SYSTEM DECISIONS

2541-7

FY 78 ACTIVITY

- AIR FORCE LED
- DATA SUPPLIED TO ARMY'S LIFE CYCLE MANAGEMENT PLANNING ACTIVITY
- NAVY IS CONSUMER OF AIR FORCE DATA AND ARMY METHODOLOGY

BUDGET FORECAST



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RESEARCH AREA DESCRIPTION
(CONTINUED)

IV. MANAGEMENT CONTROL TECHNOLOGY $876K (3.4%)

THIS AREA IS DIRECTED AT SOFTWARE CONFIGURATION MANAGEMENT AND CONTROL, AND THE DISCIPLINE ASSOCIATED WITH IT. TECHNICAL ISSUES ADDRESSED ARE CONFIGURATION ITEM DEFINITION, WORK BREAKDOWN STRUCTURE PLACEMENT, DESIGN VISIBILITY TOOLS, CHANGE IMPACT ASSESSMENT, COST/QUALITY TRACEABILITY AND ACCOUNTABILITY MECHANISMS, AND INTERFACE STANDARDIZATION AND CONTROL.

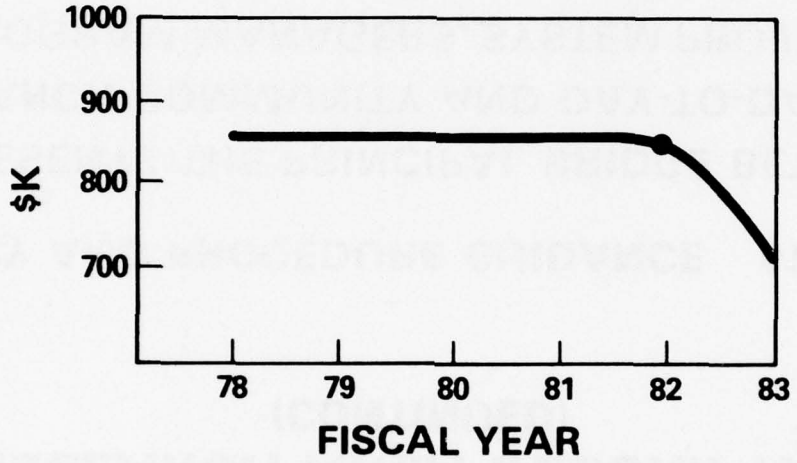
KEY POINTS

- LITTLE PREVIOUS WORK
- INTERFACES WITH BUDGETING, COST ACCOUNTING, PROCUREMENT POLICY RESEARCH
- TECHNICAL NECESSITY FOR INTEROPERABILITY (NECESSARY BUT NOT SUFFICIENT CONDITION)

FY 78 ACTIVITIES

- AIR FORCE CONCERNED WITH LOCAL, SINGLE SYSTEM ISSUES
- DARPA — CONFIGURATION MANAGEMENT AIDS FOR
  - GEOGRAPHICALLY DISTRIBUTED SYSTEMS
  - MULTIPLE SYSTEMS INTEROPERABILITY
- ARMY, NAVY, DCA TO USE AIR FORCE AND DARPA PRODUCTS

BUDGET FORECAST



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RESEARCH AREA DESCRIPTION
(CONTINUED)

V. POLICY AND PROCEDURE GUIDANCE $1.575M (6.1%)

REPRESENTS THE PRINCIPAL BRIDGE BETWEEN RESEARCH COMMUNITY AND DAY-TO-DAY WORLD OF PROGRAM MANAGERS, SYSTEM PROJECT OFFICES, AND CONTRACTING OFFICIALS. THE CORE IS A SET OF SOFTWARE ACQUISITION MANAGEMENT GUIDE-BOOKS WHICH PROVIDE A COLLECTION OF "LESSONS LEARNED," AND IMPLICATIONS OF DECISION OPTIONS AND ALTERNATIVES. CONTENT OF THE GUIDEBOOKS IS AN IMPORTANT PRODUCT, BUT TRANSFER OF IDEAS AND EXPERIENCE IS REAL PAY-OFF. GUIDEBOOKS ARE USED IN PERSONNEL DEVELOPMENT AND TRAINING INITIATIVES.

SOFTWARE ACQUISITION MANAGEMENT GUIDEBOOK TOPICS

- SERIES OVERVIEW
- REGULATIONS, SPECIFICATIONS, STANDARDS
- LIFE CYCLE EVENTS
- CONTRACTING FOR SOFTWARE ACQUISITION
- MONITORING AND REPORTING OF SOFTWARE DEVELOPMENT STATUS
- STATEMENT OF WORK PREPARATION
- REVIEWS AND AUDITS
- CONFIGURATION MANAGEMENT
- REQUIREMENTS SPECIFICATION
- VERIFICATION, VALIDATION, CERTIFICATION
- SOFTWARE MAINTENANCE
- SOFTWARE QUALITY ASSURANCE
- SOFTWARE COST ESTIMATING AND MEASURING
- SOFTWARE DEVELOPMENT AND MAINTENANCE FACILITIES

V. (CONTINUED)

KEY POINTS

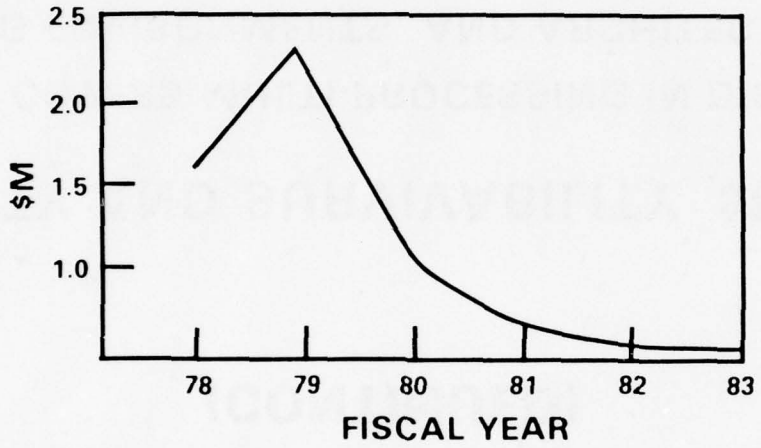
- PRIME TECHNOLOGY TRANSFER VEHICLE – INTER-GOVERNMENT AND GOVERNMENT/INDUSTRY
- RECIPROCAL IMPACT ON DODD 5000.1, 5000.2, 5000.3, MIL-STD-881, MIL-S–52779, AFR 800-14, NAVAIRINST 5230.5, ETC., ETC.
- CAPTURES LESSONS LEARNED – PM, SPO, CO ASSISTANCE
- PERSONNEL DEVELOPMENT AND TRAINING MATERIAL

2541-7

FY 78 ACTIVITY

- AIR FORCE RESPONSIBILITY FOR GUIDEBOOKS (AVIONICS, C^3, AEROSPACE)
- ARMY, NAVY – ADAPTION; PROMOTION AND USE IN RESPECTIVE SERVICES
- OSD – "COMPUTER RESOURCES AND THE DSARC PROCESS"
- ALL DOD – RESULTS FROM OTHER RESEARCH AREAS PROVIDED FOR INCLUSION
- COMMUNICATION WITH INDUSTRY

BUDGET FORECAST



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RESEARCH AREA DESCRIPTIONS
(CONTINUED)

VI. RELIABILITY AND SURVIVABILITY $1.15M (4.5%)

THIS AREA COVERS MULTI-PROCESSING IN DISTRIBUTED COMPUTING ENVIRONMENTS, AND ARCHITECTURAL IMPACTS ON SOFTWARE CORRECTNESS AND SYSTEM AVAILABILITY (e.g., FAULT TOLERANT COMPUTING, ERROR DETECTION)

KEY POINTS

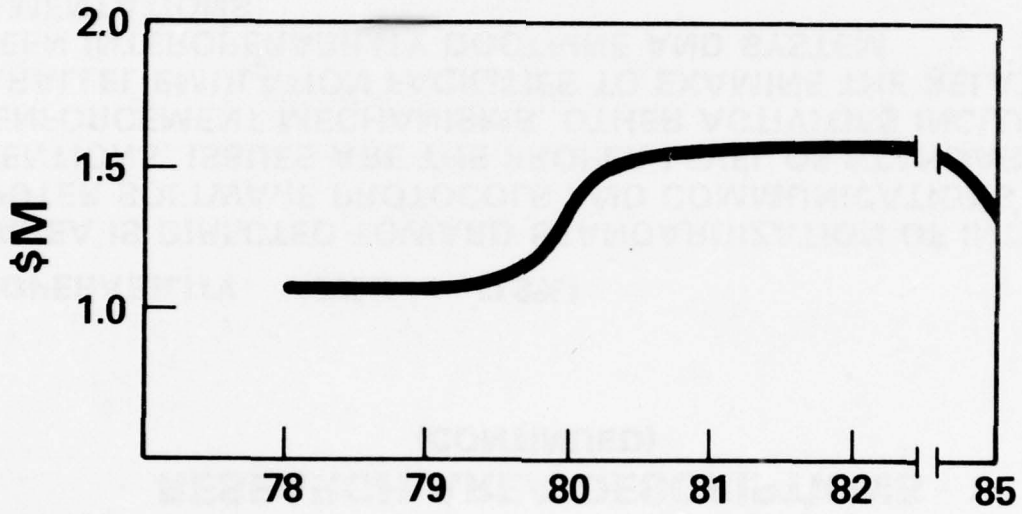
- FAULT TOLERANCE
- FAULT AVOIDANCE
- RELATIONSHIP TO SYSTEM ARCHITECTURE

2541-7

FY 78 ACTIVITIES

- WORK PERFORMED BY AIR FORCE, NAVY, DARPA
- ARMY IS USER

BUDGET FORECAST



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RESEARCH AREA DESCRIPTIONS
(CONTINUED)

VII. INTEROPERABILITY $770K (2.9%)

THIS AREA IS DIRECTED TOWARD STANDARDIZATION OF INTER-COMPUTER SOFTWARE PROTOCOLS AND COMMUNICATIONS CONVENTIONS. ISSUES ARE THE PROPER LEVEL OF STANDARDIZATION AND ENFORCEMENT MECHANISMS. OTHER ACTIVITIES INCLUDE THE USE OF PARALLEL EMULATION FACILITIES TO EXAMINE THE RELATIONSHIP BETWEEN INTEROPERABILITY DOCTRINE AND SYSTEM IMPLEMENTATIONS.

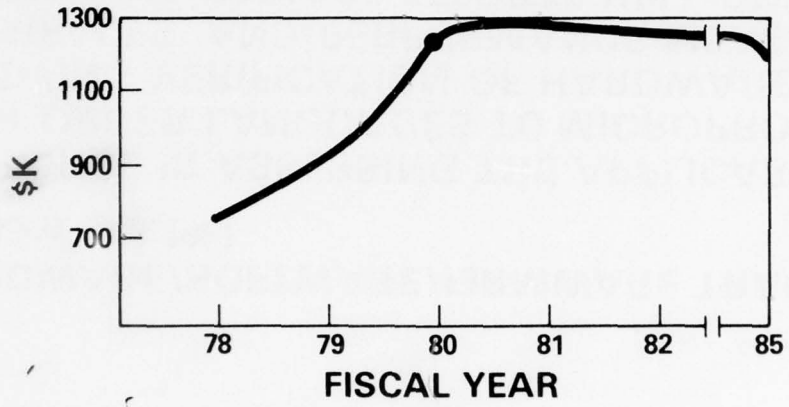
KEY POINTS

- INTER-COMPUTER PROTOCOL STANDARDIZATION
- ENFORCEMENT MECHANISMS
- IMPLICATIONS OF DOCTRINE ON SOFTWARE (RECIPROCAL) — REQUIREMENTS ASSESSMENT

FY 78 ACTIVITIES

- ALL SERVICES, DARPA AND DCA INVOLVED
- DCA LEAD IN PROTOCOL STANDARDIZATION
- ARMY – TELEPROCESSING DESIGN CENTER EMULATION FACILITY IMPACT OF INTEROPERABILITY DOCTRINE ON CANDIDATE DESIGNS FOR FUTURE SYSTEMS AND COMBINATION OF SYSTEMS – SPECIFIC EXPERIMENTS ONLY* (e.g., TACFIRE ⟷ TOS)
- DARPA/AF/NAVY JOINTLY EXPLORING INTEROPERABILITY VIA PACKET NETS, RADIO, SATELLITE

BUDGET FORECAST



* MATURATION AND EXTENSION OF TDC UNDER RESEARCH AREA X.

RESEARCH AREA DESCRIPTIONS
(CONTINUED)

VIII. HARDWARE/SOFTWARE/FIRMWARE TRADE-OFFS
$1.549m (6.1%)

AIR FORCE IS ASSESSING THE APPLICABILITY OF HIGH ORDER LANGUAGES TO MICROPROCESSORS, STUDYING VERIFICATION OF HARDWARE/SOFTWARE INTERFACES, AND PERFORMANCE MEASUREMENT/ PREDICTION. SERVICE EFFORTS WILL CONTROL PROLIFERATION AND BRING MICROPROCESSOR SOFTWARE TECHNOLOGY TO A MINIMALLY ACCEPTABLE LEVEL. DARPA IS CHARGED WITH DEVELOPING ADVANCED TECHNIQUES TO EXPLOIT THE POTENTIAL OF MICROPROCESSORS WITHOUT COMPROMISING MANAGEMENT VISIBILITY AND CONTROL.

KEY POINTS

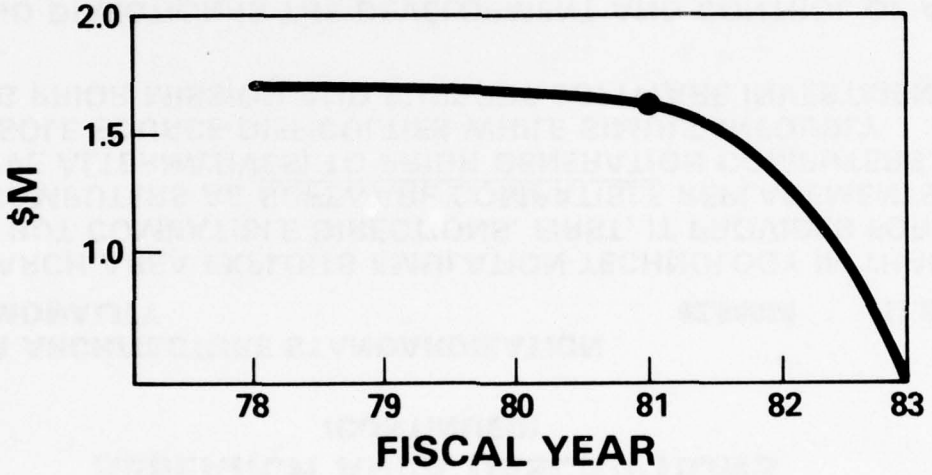
- ADDRESSES IMPACT OF MICROPROCESSORS
- LEAD TO DoD WIDE POLICY
- **EXPLOITATION WITHOUT COMPROMISING MANAGEMENT VISIBILITY**

2541-7

FY 78 ACTIVITIES

- **AIR FORCE**
  - CORRELATION OF MICROPROCESSORS AND HOL
  - VERIFICATION OF HARDWARE/SOFTWARE INTERFACES
  - PERFORMANCE MEASUREMENT/PREDICTION
- **DARPA**
  - MICROPROCESSOR EXPLOITATION AND TECHNICAL CONTROL STRATEGY
- **NAVY**
  - MANAGEMENT CONTROL STEPS (NO R&D)

BUDGET FORECAST



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RESEARCH AREA DESCRIPTIONS
(CONTINUED)

IX. COMPUTER ARCHITECTURE STANDARDIZATION AND COMMONALITY $2.980M (11.6%)

THIS RESEARCH AREA EXPLOITS EMULATION TECHNOLOGY IN THREE SEPARATE BUT COMPATIBLE DIRECTIONS. FIRST, IT PROVIDES FOR MODERN COMPUTERS AS SOFTWARE COMPATIBLE REPLACEMENTS (AND COMPETITIVE ALTERNATIVES) TO PRIOR GENERATION COMPUTERS. THIS REMOVES SOLE SOURCE DIFFICULTIES WHILE SIMULTANEOUSLY CAPTURING PRIOR MISSION AND SUPPORT SOFTWARE INVESTMENT AND MATURITY.

THE SECOND DIRECTION IS THE DEVELOPMENT AND CONTROL OF A COMMON MILITARY COMPUTER ARCHITECTURE WHICH WILL SERVE, FOR ADVANCED MISSIONS ON A TRI-SERVICE BASIS. OBVIOUSLY LONGER TERM, THIS APPROACH WILL HAVE ITS PAYOFF IN TRI-SERVICE UTILITY WITH A TRI-SERVICE/INDUSTRY SOFTWARE BASE. ARMY IS THE LEAD SERVICE IN THIS ACTIVITY WITH NAVY AND AIR FORCE CONTRIBUTING MODEST FUNDING AND ADVISORY PERSONNEL.

THE THIRD DIRECTION IS AN EXTENSION OF THE AYK-14 PHILOSOPHY INTO MICROPROCESSOR IMPLEMENTATION. THIS EFFORT IS DRIVEN BY THE NAVY.

KEY POINTS

- PROCESSOR MODERNIZATION – FULL COMPETITION WITH SOFTWARE COMPATIBILITY
- ESTABLISH AND DEFINE MINIMUM NUMBER OF STANDARD MILITARY COMPUTER ARCHITECTURES

  SHORT TERM ⟶ DODI 5000.XX ⟶ INTERIM STANDARDS

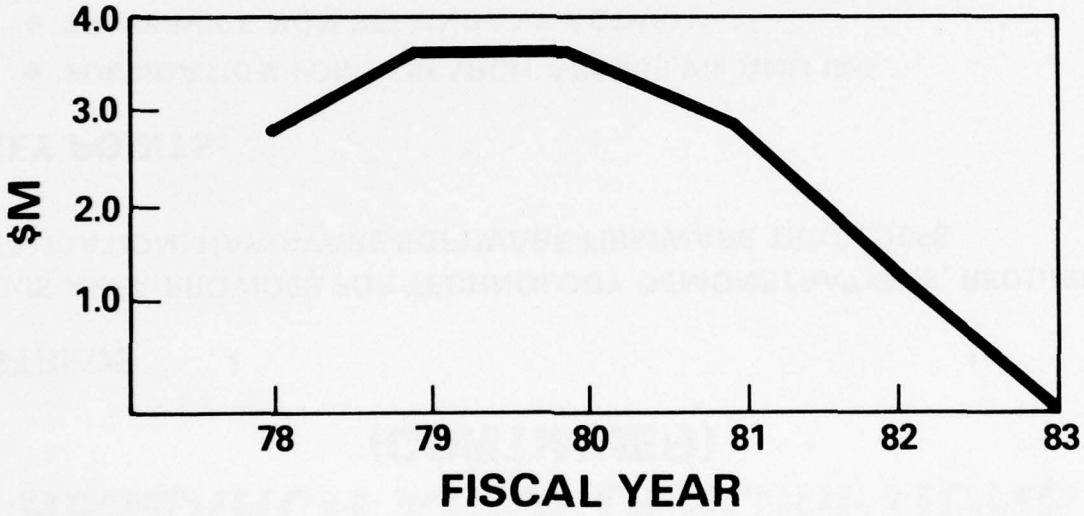
  LONG TERM ⟶ LONG TERM STANDARD??
- INCLUDES MICROPROCESSOR ARCHITECTURES

2541-7

FY 78 ACTIVITY

- STANDARD MILITARY COMPUTER ARCHITECTURE
  - SHORT TERM — TRI-SERVICE
  - LONG TERM — ARMY/NAVY
- MICROPROCESSOR STANDARDIZATION — NAVY

BUDGET FORECAST



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RESEARCH AREA DESCRIPTIONS
(CONTINUED)

X. TESTBEDS

THIS AREA PROVIDES FOR TECHNOLOGY DEMONSTRATIONS, REQUIREMENTS VALIDATION, HARDWARE-SOFTWARE-FIRMWARE TRADEOFFS

KEY POINTS:

- FOUNDATION FOR RESEARCH AREAS I,VII, AND IX
- TRI-SERVICE NON-REDUNDANT ACTIVITY
- MISSION AREA DOLLARS

FY 78 ACTIVITIES:

COMMAND & CONTROL

- WWMCCS - DCA
- FLEET RELATED - NAVY/ DARPA
- TACTICAL AIR - AF
- MILITARY MESSAGES - NAVY/DARPA

AVIONICS - AF

MANAGEMENT SYSTEMS - ARMY

TELEPROCESSING DESIGN CENTER - ARMY ($2.2M)

2541-7

RESEARCH AREA DESCRIPTIONS
(CONTINUED)

XI. FORMAL METHODS, SOFTWARE VERIFICATION AND MAINTENANCE $1.08M (4.2%)

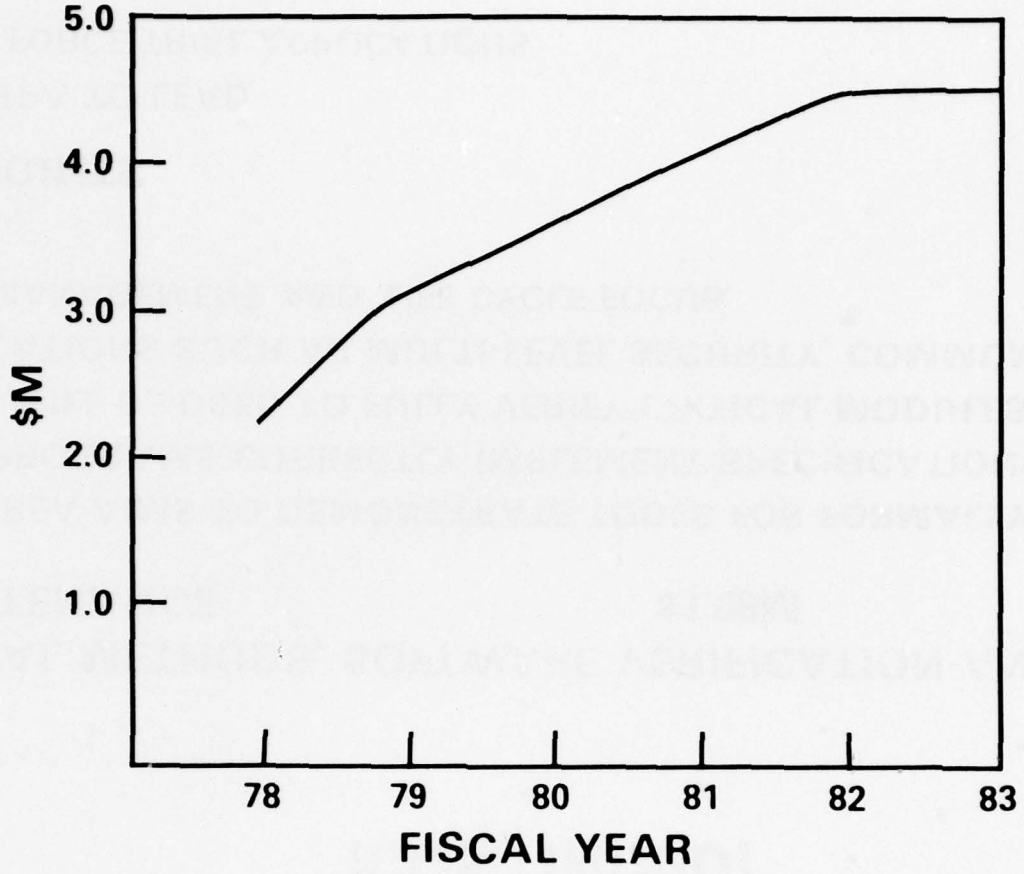
THIS AREA AIMS TO DEMONSTRATE TOOLS FOR FORMALLY PROVING THAT PROGRAMS CORRECTLY IMPLEMENT SPECIFICATIONS. INITIAL TOOLS WILL BE USED TO FULLY VERIFY CRITICAL MODULES IN APPLICATIONS SUCH AS MULTI-LEVEL SECURITY, COMMUNICATIONS, DATA MANAGEMENT AND LIFE CYCLE FOCUS.

KEY POINTS

- DARPA TO LEAD
- AIR FORCE TRIAL APPLICATIONS
- LONG TERM PAYOFF

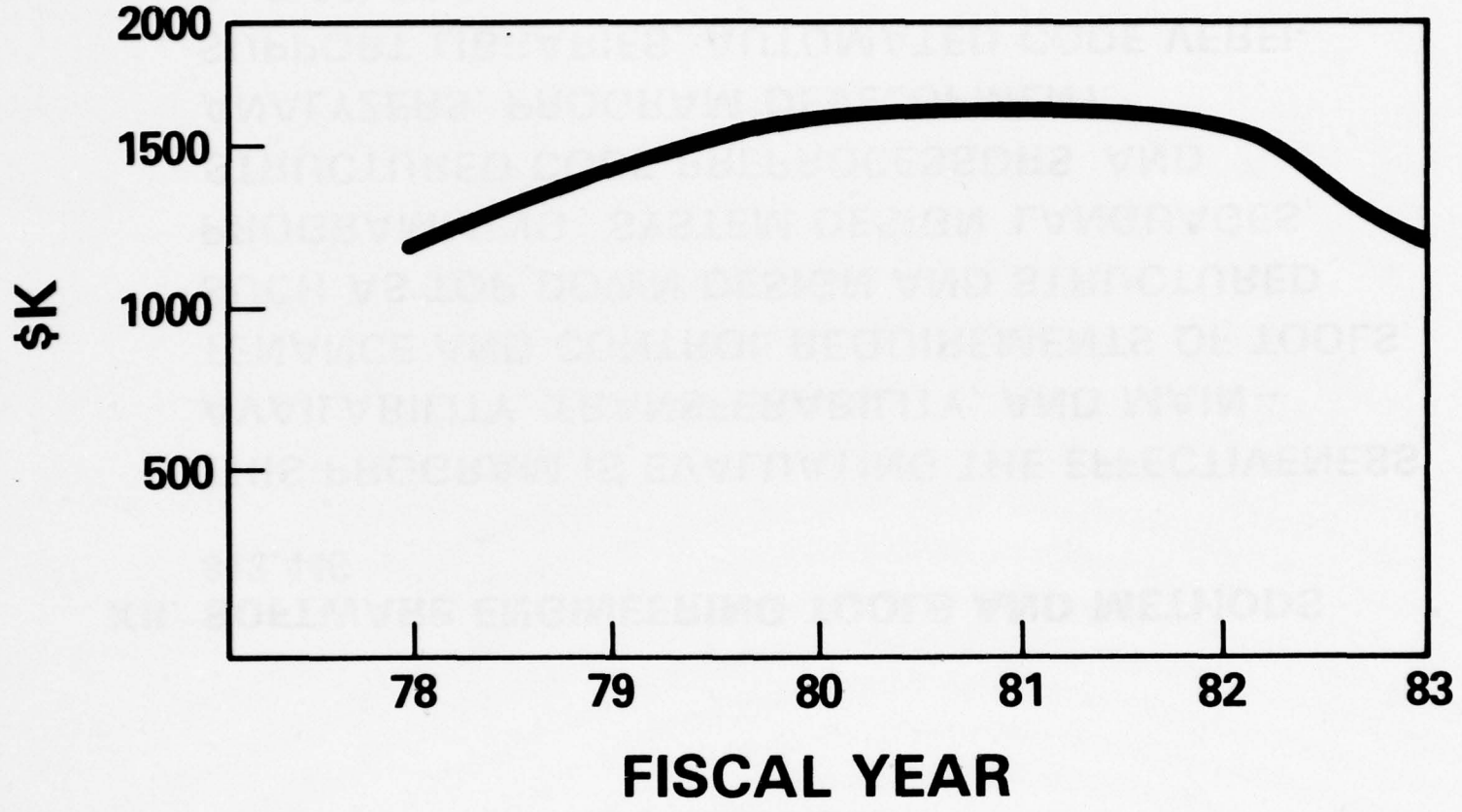
2541-7

BUDGET FORECAST



2541 7

BUDGET FORECAST



2541-7

RESEARCH AREA DESCRIPTIONS
(CONTINUED)

XII. SOFTWARE ENGINEERING TOOLS AND METHODS
$13.446

THIS PROGRAM IS EVALUATING THE EFFECTIVENESS, AVAILABILITY, TRANSFERABILITY, AND MAINTENANCE AND CONTROL REQUIREMENTS OF TOOLS, SUCH AS TOP DOWN DESIGN AND STRUCTURED PROGRAMMING, SYSTEM DESIGN LANGUAGES, STRUCTURED CODE PREPROCESSORS AND ANALYZERS, PROGRAM DEVELOPMENT SUPPORT LIBRARIES, AUTOMATED CODE VERFICATION TOOLS, SOFTWARE TEST CASE GENERATORS, AUTOMATED COMPILER GENERATORS, COMPILER VALIDATORS.

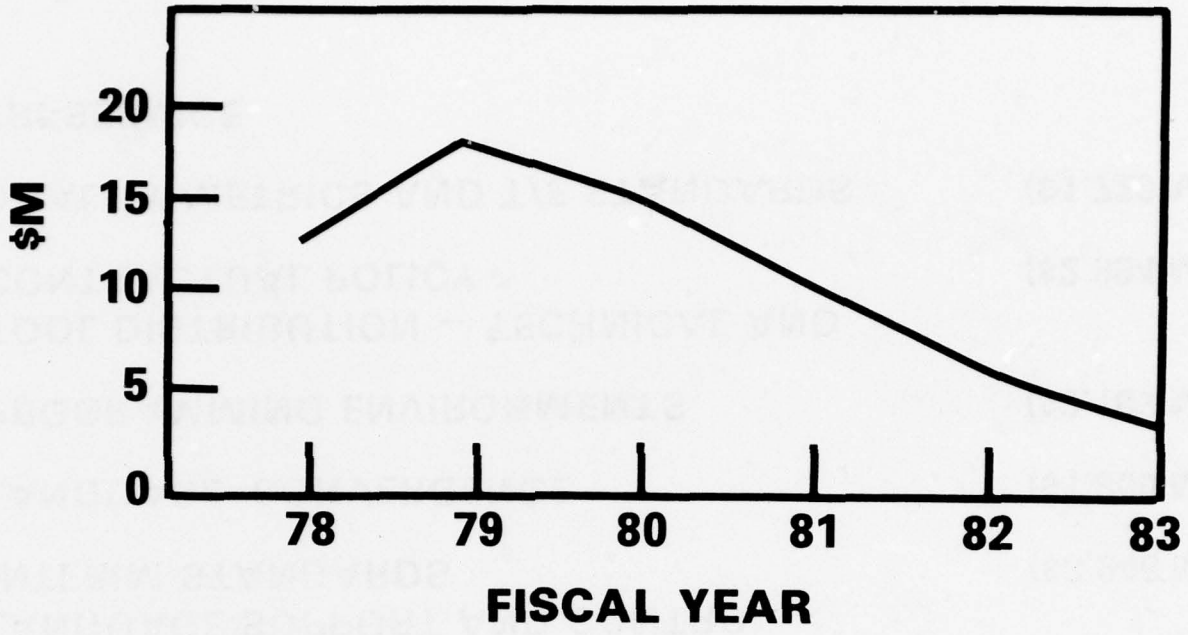
2541-7

XII. (CONTINUED)

KEY POINTS

- SPANS DEVELOPMENT/ACQUISITION/DEMONSTRATION/ EVALUATION/DISTRIBUTION
- LANGUAGE SUPPORT AND CONTROL – INTERIM STANDARDS ($3.946 M)
- LANGUAGE CONVERGENCE ($1.800 M)
- PROGRAMMING ENVIRONMENTS ($3.183 M)
- TOOL DISTRIBUTION – TECHNICAL AND CONTRACTUAL POLICY ($2.994 M)
- QUALITY METRICS AND T/E STANDARDS ($1.720 M)
- TRI-SERVICE

BUDGET FORECAST



2541-7

FISCAL 78 DISTRIBUTION SUMMARY

	AREA	
I.	REQUIREMENTS ANALYSIS	3.3%
II.	LIFE CYCLE MANAGEMENT PLANNING	2.9%
III.	COST/QUALITY DATA COLLECTION/ANALYSIS	1.7%
IV.	MANAGEMENT CONTROL	3.4%
V.	POLICY AND PROCEDURE GUIDANCE	6.1%
VI.	RELIABILITY/SURVIVABILITY	4.5%
VII.	INTEROPERABILITY	2.9%
VIII.	HARDWARE/SOFTWARE/FIRMWARE TRADE-OFFS	6.1%
IX.	ARCHITECTURE STANDARD AND COMMONALITY	11.6% ←
X.	TESTBEDS	*
XI.	FORMAL VERIFICATION	4.2%
XII.	SOFTWARE ENGINEERING TOOLS/METHODS	
	– LANGUAGE SUPPORT AND CONTROL	15.4% ←
	– LANGUAGE MODERNIZATION/CONVERGENCE	7.1%
	– PROGRAMMING ENVIRONMENTS	12.4% ←
	– TOOL DISTRIBUTION	11.7% ←
	– QUALITY METRICS/T&E STANDARDS	6.7%

* MISSION AREA FUNDING

2541-7